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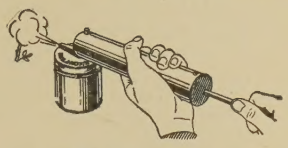

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Smit (C. J. B.). **Field Observations on the Brown Locust in an Outbreak Area.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 190, 143 pp., 34 figs., 19 refs. Pretoria, 1939. Price 1*s*.

From 1935 to 1938, field investigations were carried out in Cape Province in the Middelburg outbreak area of *Locustana pardalina*, Wlk., where intensive studies were confined to the Doornberghoek outbreak centre.

A general description is given of the relief, climate, vegetation, fauna and agriculture of the area ; the outbreak centres occur in the sheep-farming districts. The technique employed in determining the population densities of hoppers and adult locusts is explained. In hopper populations of one or less per square yard, it is recommended to use the " distance method " of counting the number of hoppers along a straight line between two points ; another method consisted of " combing " or counting the hoppers along parallel straight lines, and a third of counting those observed in a given time when walking at a uniform speed. When the density was over one hopper per square yard, the best results were obtained by counting the hoppers caught in portable enclosures covering a given area. For adults, the most accurate results were obtained by the distance and combing methods, particularly under a clear sky and at air temperatures above 70°F. The conversion of results obtained by the " time " and distance methods into population per unit area is explained.

During each of the seasons 1935–36 and 1936–37 two generations were produced, but in 1937–38 there were three, culminating in the appearance of incipient bands during the last generation. The maximum and minimum incubation periods were 17 and 8 days, at mean air temperatures of 62°F. and 67–72°F., respectively. The duration of larval development in phase *solitaria* varied with temperature ; it appears to be retarded in phase *transiens* by an increase in muscular activity. The average durations were 24·3, 31·5 and 39 days in phases *solitaria*, *transiens* and *gregaria*, respectively. The adults lived for about 12 weeks. Measurements of eggs were made at different stages of genital development ; they are laid when they are about 6 mm. long. The average numbers of eggs per egg-pod were 37 and 44 in phases *solitaria* and *gregaria*, respectively. Oviposition is described ; a *solitaria* female is calculated to lay about 4 egg-pods.

Detailed biometrical studies revealed a distinct tendency in the second generation of the 1936–37 season to vary in the direction of phase *gregaria*. Since this generation had a lower population density than the first, while the air temperature under which it existed was higher, this variation may have been caused by greater heat and drier food. A minimum rainfall of 0·40 in. and average monthly temperatures of 58°F. for September–March and 61°F. for April–May are provisionally accepted as essential for general hatching. On this basis, the usual number of generations during years with precipitation below normal is two ; under optimum conditions, four generations may be produced in one season.

Observations were made on hoppers in populations of different densities, to which their coloration was related. Thus, the coloration of phase *gregaria* was noted after the appearance of migrating bands. In hoppers of phase *solitaria* with a population density of less than two per square yard, there was some movement to avoid moving objects and extremes of temperature, and some concentration on

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patches of green vegetation. In loose bands of phase *transiens congregans* covering 1–100 square yards and with population densities from 10 per square yard, there were no definite migrations, but much aimless crawling and hopping in all directions. Migrating bands were first observed in the seventh generation, the critical density for migration being 450 individuals per square yard in the first instar, 150 in the third and 50 in the fifth.

In adults of phase *solitaria* no migrations could be observed, though distribution studies indicate that movement to and from oviposition sites must take place. In loose swarms of phase *congregans*, with densities of one or more per square yard, definite migrations could be observed. It is concluded that hoppers must be the critical stage in phase transformation, for the swarms of adults migrated only after migrating hopper bands had made their appearance. The influence of activity in the adult stage is probably limited to its effect on the coloration of the progeny.

The outbreak centres of *L. pardalina* are characterised by the presence of alternating zones of vegetation, and the varying distribution of the locust in them led to their subdivision into oviposition sites, concentration belts and unfrequented stretches. The ecological characteristics of the divisions are described. The oviposition sites are on relatively elevated ground, with shallow sandy soil overlying limestone, overgrown by short grass carpets of *Enneapogon brachystachyus* and *Eragrostis* spp. and by small shrubs. The concentration belts, to which the young adults migrate, are on lower ground with deep clayey loam, on which the vegetation consists of small shrubs and dense tall grass alternating with patches of bare soil. Unfrequented stretches consist of bare stony hills and ridges, continuous stands of dense tall grass and stretches of very compact clays, which cake in the dry season, overgrown by small shrubs of *Nestlera* and *Eragrostis bicolor*. The oviposition sites and concentration belts are subject to contraction and expansion according to climatic fluctuations and the degree of grazing, and further studies on the exact effects of these factors are essential.

During the period of investigation, there was a high rate of mortality, especially among the hoppers, which was probably due to natural enemies, including Asilid flies, Solpugids, scorpions, birds and lizards, and to adverse weather conditions. There was, however, a gradual increase of the total locust populations, a progression factor of about 4 per generation representing the rate of increase at Doornberghoek. The rainfall during the period was below the average, and this, together with heavy grazing and trampling by sheep, resulted in the expansion of the oviposition sites, which favoured the increase in numbers and an extension of the area subject to outbreaks during 1937–38. The same factors led to a contraction of the concentrating belts, and increased the concentration of adults, but owing to the increase of the oviposition area, egg-laying was scattered, and the conditions favouring concentrations of hoppers were lacking.

A brief comparison is made of the natural conditions in the Middelburg, Bethulie and Kenhardt outbreak areas [*cf. R.A.E.*, A **26** 684]. A gradual increase of locust populations occurred in all three ; in Middelburg and Bethulie they were due to increases of local populations ; in Kenhardt, the transformation to phase *gregaria* was more rapid and complete, owing to a possible greater density of the initial population or to infiltration of locusts from South-West Africa.

ROGERS (W. S.), KING (M. E.) & MASSEE (A. M.). **Results of Researches in Strawberry Growing.**—*Sci. Hort.* **7** pp. 71–84, 2 pls., 2 figs., 18 refs. Wye, Kent, 1939.

This paper contains reviews by King and Massee, respectively, of work in England on the virus diseases of strawberries, crinkle and yellow-edge, and on the two pests, *Tarsonemus pallidus*, Banks (*fragariae*, Zimm.) and *Capitophorus potentillae*, Wlk. (*fragariae*, Theo.), of which the latter is the vector of yellow-edge [*cf. R.A.E.*, A **23** 290; **24** 652; **25** 665] and probably of crinkle [*cf.* **22** 188].

In a susceptible variety, such as Royal Sovereign, the symptoms of yellow-edge are frequently masked during most of the year, but they usually show quite clearly in late summer and autumn. Since the runners produced by diseased plants are infected, however healthy they may appear, all infected plants and runners should be removed from propagation beds in order that new fruiting plantations can be planted with healthy runners. The propagation beds should be inspected regularly during the summer and autumn, and all infected and suspicious plants should be removed. Different varieties of strawberry experimentally infected with the virus showed symptoms to a varying degree. Those that showed them readily were classed as susceptible, and those that rarely showed them, although they were infected, as carriers. Some varieties were intermediate between the two extremes. The symptoms in all varieties vary, and carrier plants may deteriorate as much as susceptible ones. A list of varieties grouped into the three categories is given. Susceptible varieties should not be grown with varieties of the other two groups nor with unrogued susceptible plants. New beds should be planted as far from existing ones as possible.

The crinkle found on Royal Sovereign in the west of England is considered to be the same disease as that found in the United States [**22** 188, etc.]. Small chlorotic spots, which do not grow, develop on the young leaves, which become distorted and wrinkled. In severe cases, the spots increase considerably and develop a brownish purple necrotic centre, and the leaves are badly distorted. The existence of mild and severe forms of the disease in the same plantation, which has also been observed in the United States, suggested the presence of two distinct diseases, as only a small number of the plants became severely affected. Mild crinkle is very widespread, but does so little damage that it is frequently unnoticed and need not be eliminated, whereas plants suffering from severe crinkle, which is dangerous, must be removed. As the symptoms of the early stages of severe crinkle are indistinguishable from those of the other form, it is necessary to wait until definite signs of severe disease develop before removing the plants, in order to avoid wasting good plants. Plants suffering from yellow-edge may also be infected with crinkle, which is then frequently invisible.

The Aphids may be controlled in the field by a spray consisting of 8 oz. nicotine (95–98 per cent.), 6–8 lb. soft soap and 100 gals. water, applied in the latter part of May just before the migration period, which rarely lasts more than a week, and in June when the winged generation has finished flying. Derris sprays and dusts, nicotine dusts and an atomised spray of pyrethrum did not give satisfactory control. In preliminary tests, atomised nicotine (1–10 per cent. solutions in water) was very effective. Burning the straw litter as soon as the

picking season is over destroys the Aphid, but has little effect on the mite, which can only be controlled by immersion of the runners in warm water [*cf.* **22** 234, etc.].

KEARNS (H. G. H.) & MARTIN (H.). **The Position of Combined Washes in the Post-dormant Spray Programme.**—*Sci. Hort.* **7** pp. 96–118, 27 refs. Wye, Kent, 1939.

The successful combination, in one spray, of two or more active insecticidal or fungicidal constituents of known biological properties is dependent on a knowledge of the physical properties contributing to good field performance. Behind the simple list of ingredients of the combined wash there is an important theoretical basis, a knowledge of which is not essential to those who are interested only in the practical side. This paper is therefore divided into two parts, theoretical and practical.

In the first part, fundamental considerations are discussed concerning the physical properties of sprays in relation to their direct and protective insecticidal and fungicidal properties [*cf. R.A.E.*, A **26** 370, etc.]. Methods whereby sprays can be made suitable for overspraying without serious sacrifice of protective qualities or increase in phytocidal action are outlined, the comparative merits of water-soluble and water-insoluble spray supplements indicating that oil emulsions afford the most promising basis of combined direct and protective sprays.

In the second part, particulars are given of some of the important materials used in post-dormant combined sprays, and spray programmes based on their use are outlined for apples, plums, currants and strawberries in England.

FRANSEN (J. J.). **Iepenziekte, iepenspintkevers en beider bestrijding.** [Elm Disease, Elm Bark-beetles, and the Control of both.]—Proefschr. Landb Hoogesch. Wageningen [8] 118 pp., 6 pp. refs. Wageningen, 1939. (With a Summary in English.)

In this thesis is given a comprehensive and detailed survey of the work done, mainly in Holland, since 1930 on disease of elms caused by *Ophiostoma* (*Ceratostomella*) *ulmi* and the elm bark-beetles, *Scolytus scolytus*, F., and *S. multistriatus*, Marsh. The main subjects dealt with comprise the transmission of the fungus by these beetles, their maturation feeding, number of annual generations and epidemiology, and measures for control. Most of the information has been noticed from previous papers, including several by the author [*R.A.E.*, A **19** 499; **20** 4, 659; **23** 735; **25** 796].

Newly emerged adults of *S. scolytus* feed mostly near the site of emergence; hence elms at the edges of plantations and those at street corners are heavily infested. Maturation feeding lasts 8–10 days and if the weather is fairly favourable, takes place from the end of April to mid-October, so that individuals that emerge late can complete feeding, although they do not overwinter. In Holland, the winter is passed by the immature larvae in the bark, and by fully-grown ones in the pupal cells. Pupation takes place in spring, and there are usually three generations a year, although a fourth sometimes develops. *S. multistriatus* generally hibernates as an immature larva, and the adults therefore appear later than those of *S. scolytus*. The numbers

of the sexes are about equal in both species; females of *S. scolytus* deposit 8–156 eggs, generally 60–110, and those of *S. multistriatus* 8–200, generally 100–150. Natural enemies are discussed; the most important is the Braconid, *Coeloides scolyticida*, Wesm., which parasitises the larvae, preferring those of *S. multistriatus*.

The availability of suitable breeding material is the most important condition determining outbreaks of both beetles. Trees killed by the fungus are specially favoured for brood galleries. In early summer, these galleries are formed in healthy elms immediately after felling, as the wood dries rapidly, but trees felled in winter often sprout in spring, and are unsuitable for attack. In trees felled in spring and summer, very thick trunks are attacked before thin ones, since the beetles are able to bore in the thick bark without touching the living, sap-exuding cambium. Elm trunks that have been felled for a considerable period are quite unattractive.

No method of controlling the fungus is known. Methods of controlling the Scolytid vectors are discussed [*cf.* **23** 735], and the results are given of experiments with a large number of chemicals, some of which appeared to repel the beetles. The best methods are still to bark the wood, which diminishes its value, or to immerse it in water for six months, which increases it.

Schedl (K. E.). **Blattwespenkokongrösse und Fruchtbarkeit der schlüpfenden Weibchen.** [The Size of the Cocoons of Sawflies and the Fertility of the resulting Females.]—*Anz. Schädlingsk.* **15** pt. 3 pp. 25–29, 4 graphs. Berlin, 1939.

The measurement of cocoons of the pine sawfly, *Diprion* (*Pteronus*) *pini*, L., collected in the spring of 1936 near Danzig, and in the spring of 1937 at Meppen, near the Dutch frontier, showed that their size, expressed as diameter, was dependent on sex, the female cocoons having the larger average diameter [a sex relationship that was erroneously reversed in the author's previous paper (*R.A.E.*, A **27** 105)]. When the cocoons from Meppen were divided into diameter classes, those of the two classes having diameters of 3·5 mm. and less all gave rise to males, and those of the two in which they were 5·7 mm. and over to females. When cocoons of the five classes having diameters of less than 4·1 mm. were regarded as males, the percentages of males and females were 31·9 and 68·1, respectively, which agreed closely with the actual percentages of 31·6 and 68·9 [*sic*]. In the case of material from Meppen, examination of the ovaries of 875 newly emerged females and measurement of the respective cocoons showed a direct relation between the diameters of the latter and the number of mature eggs, which averaged 52·7 per female. Application of these data to cocoons from the Danzig region indicated an average of 62 mature eggs per female, but examination of 376 females showed the average to be 108·2 [*loc. cit.*]. There was therefore a difference of nearly 100 per cent. for cocoons of the same diameter classes. In the Danzig region, most of the cocoons were in the forest litter (the normal situation), but at Meppen most of them were in cracks in the bark of the lower parts of the trunks. The author ascribes this to unfavourable weather conditions and considers that fertility was adversely affected thereby.

Birds prefer the large female cocoons and are considered responsible for an increase to at least 45 in the calculated percentages of males

in the summer generation of 1936 in the Danzig region. Rodents destroy both sexes equally. Cocoons of the first or summer generation are spun on the needles or thin twigs. Parasites, such as Tachinids, of which the most numerous is *Sturmia inconspicua*, Mg., leave the cocoons to pupate in the ground; details are given of the position of the cocoons and of the direction in which the adult sawfly or Tachinid larva emerges.

BERTRAM (L.) & MANNHEIMS (B.). **Die Zikade** *Cicadella viridis* **L. als Obstbaumschädling.** [The Cicada, *C. viridis*, as a Pest of Fruit Trees.]—*Anz. Schädlingsk.* **15** pt. 3 pp. 29–31, 2 figs., 4 refs. Berlin, 1939.

In the Rhineland of recent years, considerable injury has been caused to young fruit trees, especially apple, pear and plum, by wounds and cuts for oviposition in the stems, branches and twigs by *Cicadella viridis*, L. The trees are weakened and rendered more susceptible to attack by other pests. The fertilised females appear about 15th–20th October, and also oviposit in poplars, willows and alders. Adhesive bands, applied at the end of September to the trunks at a height of about 6 inches above the ground, gave complete protection against the Jassid; such bands would normally be of value also against the winter moth [*Operophtera brumata*, L.].

SCHAERFFENBERG (B.). **Die Nahrung der Sandschnellkäferlarve (*Lacon murinus* L.).** [The Food of the Larvae of *L. murinus*.]—*Anz. Schädlingsk.* **15** pt. 3 pp. 31–32, 5 refs. Berlin, 1939.

An account is given of investigations at Bonn on the feeding habits of the larvae of the Elaterid, *Lacon murinus*, L., which is usually regarded as a pest of cultivated plants. In the laboratory, larvae of *Agriotes* sp. and *Corymbites* (*Selatosomus*) *aeneus*, L., fed on slices of potato and young lettuce plants, but larvae of *L. murinus* did not. In a further test, the latter attacked small earthworms and small larvae of *Melolontha* and *Anomala* (*Phyllopertha*). It would therefore appear that they are predacious, though it is possible that they also take vegetable food in the field. They are of frequent occurrence in regions in which *Melolontha* is prevalent.

SATTLER (H.). **Die Entwicklung der Nonne, *Lymantria monacha*, in ihrer Abhängigkeit von der Nahrungsqualität.** [The Development of the Nun Moth in Dependance on Food Quality.]—*Z. angew. Ent.* **25** pt. 4 pp. 543–587, 29 figs., 34 refs. Berlin, 1939.

A detailed account is given of investigations in 1936 and 1937 on the influence of food on the duration of development, mortality, and fertility of *Lymantria monacha*, L., and the assimilation of food by the mature larvae. The technique used is described. The larvae were bred from eggs collected in Germany and Poland. In nature, development of a population depends primarily on coincidence between the appearance of the first-instar larvae and the opening of the buds of the food-plant, so that in the case of some plants the results in nature might be less favourable than those obtained by the author in the laboratory, where the most suitable food was always supplied.

The following is taken from the author's summary, in which the pairs of figures given for spruce are due to the fact that it was the

only food-plant tested in both years: The average numbers of days required for development from hatching to adult emergence were 47 on larch, 49 on beech, 50 on oak and apple, 52 and 53 on spruce, 56 on pine, and 69 on alder. The percentage mortality during development was about 2 with apple, oak, spruce and larch, 18 with beech, 61 with pine and 89 with alder. The average numbers of eggs per female were 269 with oak, 261 with larch, 238 with apple, 227 with beech, 211 and 195 with spruce, 160 with pine, and 68 with alder. At 20–22°C. [68–71·6°F.] and a relative humidity of 75 per cent., the weight of dry material consumed daily by larvae of the same age was greater for beech than alder, and greater for spruce than beech. Corresponding results were obtained as regards excreta and assimilated food. Details are given of the food consumed and assimilated at different temperatures.

KUNIKE (G.). **Beiträge zur Lebensweise und Bekämpfung der Mehlmotte, *Ephestia kuehniella* Z. (Pyralidae, Phycitinae).** [Contributions on the Life-history and Control of the Flour Moth.]—*Z. angew. Ent.* **25** pt. 4 pp. 588–608, 12 figs. Berlin, 1939.

A detailed account, based on the author's investigations in Germany, is given of the bionomics of *Ephestia kuehniella*, Zell., all stages of which are described, and notes on its rearing in the laboratory are included.

The adults do not require food or water and pair soon after emergence, the sexes occurring in approximately equal numbers. The duration of adult life depends on temperature and on pairing; at 22°C. [71·6°F.] it is 6–9 days after pairing or oviposition. Unpaired males live for 8–13 days at room temperature, and females for 11–14. Some moths can be found in steam flour mills at all times of the year, but most of the mature larvae hibernate in their cocoons, in which they pupate in spring, and the adults occur chiefly in April–May, in July and in September–October. The maximum number of eggs observed for a female was 562, the average being about 300. All may hatch at temperatures between 21 and 31·5°C. [69·8–88·7°F.] and optimum humidities. Above 32°C. [89·6°F.] the eggs are desiccated; below 12°C. [53·6°F.] they retain their capacity for development for up to 30 days. The normal incubation period of 6 days was prolonged by the actual number of days eggs were kept at 4°C. [39·2°F.]. The percentages of eggs that hatched after being kept at this temperature for 3, 21, 24, 27 and 30 days were 98, 10, 1, 0·1 and 0, respectively. At the temperatures and humidities normal in summer in flour mills, 88–99 per cent. of the eggs hatch, and mortality in the larval and pupal stages is also slight. In 10 tests with batches of 100 eggs, the minimum number of adults was 71 and the maximum 86, with an average of 78·7.

The newly hatched larvae at once seek food, but can survive without it for 1–2 days. The larval stage lasts at least 24 days at a favourable temperature (26°C. [78·8°F.]) and may require over a year at lower temperatures or with unsuitable food [*cf. R.A.E.*, A **27** 64]. The average duration of the pupal stage is 12 days at 22°C. and 8 days at 26°C. The young larvae can resist temperatures below 12°C. for longer than the eggs, and old larvae and pupae can withstand temperatures down to freezing point for several months.

E. kuehniella has a number of natural enemies ; reference is made to papers on the Hymenopterous parasites, *Microbracon hebetor*, Say (*brevicornis*, auct.) and *Nemeritis canescens*, Grav. [**10** 566 ; **20** 491]. The adults and larvae of two other flour pests, *Tribolium castaneum*, Hbst. (*navale*, auct.) and *Tenebroides mauritanicus*, L., and the mite, *Pediculoides ventricosus*, Newp., attack the larvae and pupae, and another mite, *Typhlodromus tineivorus*, Oudm., feeds on the eggs. The first signs of infestation in a flour mill are the fine threads hanging down from the machinery. The webs then become thicker. The most effective method of chemical control is fumigation with Zyklon ; the methods of using this fumigant and Areginal are described.

GÄBLER (H.). **Schädigungen an Laub- und Nadelholz durch Novosil und verwandte Stäubemittel und deren Wirkung auf Nonnenraupen und *Nematus*larven.** [Injuries to deciduous and coniferous Trees by Novosil and allied Dust Insecticides and the Action of the Insecticides on Larvae of the Nun Moth and *Nematus*.] —*Z. angew. Ent.* **25** pt. 4 pp. 609–627, 2 figs., 5 refs. Berlin, 1939.

Injury to trees dusted with dinitro-ortho-cresol led to a series of experiments, here recorded in detail, to test the effect on conifers and foliage trees and on some insects of Novosil and a number of other proprietary preparations containing this compound. All of them were about uniformly toxic to larvae of *Lymantria monacha*, L., and sawflies and caused approximately the same amount of injury to the plants. In unmixed pine stands, they can be used without injury if applied very early in the year before the May shoots appear. They may also be applied to spruce in the very rare case of a pest appearing before the spruce buds are out. With larch and all deciduous trees, injury cannot be prevented, but it varies with the tree, aspen [*Populus tremula*] being especially sensitive. While the development of a pest necessarily governs the date of application, it is possible to choose a time when the tree in question is best able to resist injury, either before the needles or foliage have appeared or when they have hardened. In the case of hairless larvae, pyrethrum or derris may be used, and these do not scorch the May shoots, but as their insecticidal action is relatively slow, the author advises the use of a new proprietary contact dust [*R.A.E.*, A **27** 231], which is speedier in action though less so than dinitro-ortho-cresol.

HANNO (K.). **Anlockversuche bei *Lymantria monacha* L.** [Experiments in attracting *L. monacha*.]—*Z. angew. Ent.* **25** pt. 4 pp. 628–641, 3 figs. Berlin, 1939.

The author carried out experiments in Saxony in 1937 on the value of Dyk's method of estimating the prevalence of *Lymantria monacha*, L., in a forest by using females to attract the males [*R.A.E.*, A **21** 299]. The technique adopted is described and the results discussed. The latter agree substantially with those obtained by Ambros [**26** 659], whose work was unknown to the author when he was making his experiments. He does not, however, agree with Ambros that the method might be developed into a measure for control, because it is not possible to capture the majority of the males before they have fertilised one or more females.

NOLTE (H. W.). **Die Laubheuschrecke** *Barbitistes constrictus* **Brunn. als Forstschädling.** [*B. constrictus* as a Forest Pest.]—*Z. angew. Ent.* **25** pt. 4 pp. 642–646, 1 fig., 12 refs. Berlin, 1939.

It has been suggested that the Tettigoniid, *Barbitistes constrictus*, Brunn., is predacious on *Lymantria monacha*, L., but the general view that it is phytophagous was confirmed by the author's observations in Saxony, where it attacked spruce and pine in 1938. Captive individuals readily accepted larch and would also feed on beech, but did not touch larvae or adults of *L. monacha*. No serious damage to the trees was observed, but a loss of 50 per cent. of the needles of young pines has been recorded in Poland [*R.A.E.*, A **16** 497]. The bark of the youngest twigs and the terminal buds are also attacked, and in the case of larch the tender twigs are often bitten through in the middle, so that young trees might be considerably injured.

FRANCKE-GROSMANN (H.). **Ueber das Zusammenleben von Holzwespen (Siricinae) mit Pilzen.** [On the Symbiosis of Wood-wasps with Fungi.]—*Z. angew. Ent.* **25** pt. 4 pp. 647–680, 18 figs., 37 refs. Berlin, 1939.

The symbiosis between Siricids and fungi has been little investigated, mainly owing to difficulty in obtaining material. After a brief survey of some publications on this subject, the author reports in detail the results of work done by her at intervals during the past 10 years with German wood-wasps, of which the more important species were *Sirex* (*Xeris*) *spectrum*, L., from pine and spruce; *S.* (*Paururus*) *juvencus*, L., from pine, spruce and *Abies*; *S.* (*P.*) *noctilio*, F., from pine; *S. gigas*, L., from spruce; and *Tremex fuscicornis*, F., from poplar and walnut. *Sirex phantoma*, F., and *Tremex magus*, F., were available only as dry museum material, but inferences could be made by analogy. The author concludes that all these wood-wasps, except *S. spectrum*, live in constant symbiosis with wood-destroying fungi. The hyphae and oidia are found in specific intersegmental organs of the females, called fungus sprays by Buchner. These organs are filled with a mucus, and the oidia, which develop into normal mycelia, are bedded in it. During oviposition, some of the mucus is squeezed out and adheres to the egg. The mycelia develop in the wood in which the larvae feed. There are only a few hyphae in wood infested by *Sirex*, and such wood differs little from sound wood, but hyphae abound in wood infested by *Tremex fuscicornis* (and presumably by *T. magus* also) and the wood is much damaged. The fungi destroy both the cellulose and the lignin. The kinds of mycelia found in the females of various species show that a given species is not always associated with the same fungus.

The intestinal juices of the larvae digest the hyphae quickly and completely. The fungi were easy to culture from the organs of freshly killed females or from the wood, but identification was seldom possible as sporophores were difficult to obtain.

From the practical point of view there is, in addition to the mechanical injury done by Siricids, a transmission of wood-destroying fungi. Furthermore, if infected timber is used for building, there is the risk of rot in damp situations, unless deep impregnation with a preservative has killed the oidia in the wood.

Böttcher (F. K.). **Untersuchungen über den Einfluss von Pflanzenschutzmitteln auf die Bienen. IV. Teil : Die Wirkung von Derris auf die Bienen.** [Investigations on the Effect on Bees of Materials used in Plant Protection Work. Part IV. The Action of Derris on Bees.]—*Z. angew. Ent.* **25** pt. 4 pp. 681–702, 4 graphs, 16 refs. Berlin, 1939.

The following is taken from the author's summary : Derris acted on honey bees both as a stomach and contact poison, but not as a respiratory poison. Temperature had little effect on its action. As a stomach poison, the minimum lethal dose for pure rotenone in a 0·2 per cent. suspension varied from 0·5 to over 11 mmg. according to individual and temperature, the average being about 3 mmg. To kill 25–33·3 per cent. of the test bees, 0·6 and 1·7 mmg. rotenone were necessary at temperatures of 20 and 34·5°C. [68 and 94·1°F.], respectively. Derris extracts containing the same amount of rotenone were more active, the minimum lethal dose being between 0·5 and 5·6 mmg. rotenone, with an average of 2·2 mmg. With about 1·1 mmg., 25–33·3 per cent. of the bees died in 3 days. The results with derris as a contact insecticide were not quite uniform, but derris extracts were again more toxic than suspensions of pure rotenone. Only few of the bees sprayed with derris at the concentration of 0·02 per cent. customary for pest control suffered serious injury.

Based on the author's previous work with nicotine and pyrethrum [*R.A.E.*, A **27** 101, 231] and with weed killers, lists are given showing the amounts of these and of pure rotenone and derris extract required to kill 25–33·3 per cent. of the bees. A table shows mortalities with rotenone used as a contact poison at temperatures from 20 to 34·5°C.

Field experiments were made on a small scale in a cage and on a large scale in fields of flowering plants attractive to bees. The extermination of bees has been ascribed to derris [**24** 17 ; **25** 423], but in the author's experiments a derris dust containing 1·75 per cent. rotenone and sprays of usual strength (0·02 per cent.) and double strength had no serious effect on them.

Wünn (H.). *Eulecanium bulgariense* **n. sp., ein Schädling der bulgarischen Oelrosenkulturen aus der Familie der Cocciden. (14. Mitteilung über Cocciden.)** [*Lecanium bulgariense*, sp. n., a Coccid Pest in Bulgarian Oil Rose Plantations.]—*Z. angew. Ent.* **25** pt. 4 pp. 703–708. Berlin, 1939.

A Coccid that was observed in Bulgaria in 1927 on roses grown for the essential oil and was then considered to be a species of *Physokermes* [*cf. R.A.E.*, A **19** 427] is here described from both sexes as *Lecanium* (*Eulecanium*) *bulgariense*, sp. n. Infested plants wither in 3–4 years. The winged males appear in the second half of April, and the females oviposit from mid-June onwards. The larvae are very active from 25th June to 5th July, but soon afterwards settle on inner and lower branches, on which they hibernate. Infestation is most common in high and dry situations. The measures in use have been rubbing off the scales with rags and cutting off infested branches, but tar distillates applied in the dormant period have proved effective insecticides in experiments. Natural enemies have already been noticed [*loc. cit.*].

Nowicki (Ś.). **Wrogowie i sprzymierzeńcy naszych lasów sadów i pól ze świata owadów.** [Insect Enemies and Allies of our Forests, Orchards and Fields.]—*Bibliot. biol.* no. 12, 56 pp., 21 figs. Lwów [1938].

A popular account is given of various factors that affect the abundance of insect pests, the subjects discussed including the balance of nature and its disturbance by man, the introduction of pests into new countries, the habits and importance of predators and parasites, the effect of weather, and biological control. Notes are also given on the bionomics and control of some pests that occur in Poland, including the migratory locust [*Locusta migratoria*, L.], the Moroccan locust [*Dociostaurus maroccanus*, Thnb.], Pentatomids of the genus *Eurygaster* that attack cereals, and Aphids, particularly *Phylloxera* infesting vines.

[Buzin (N.), Printz (Ya.), Lazarevskiĭ (M.), Negrul' (A.) & Katz (Ya.).] **Бузин (Н.), Принц (Я.), Лазаревский (М.), Негруль (А.) и Кац (Я.). Viticulure.** [*In Russian.*]—Demy 8vo, 824 pp., 305 figs., 24 graphs, 378 refs. Moscow, Sel'khozgiz, 1937. Price 10 *rub.* 30 *kop.* [Recd. 1939.]

One chapter of this book, by Printz (pp. 639–800), deals with pests and diseases of vines occurring in the Russian Union. The pests are divided into four groups according to the degree of their association with the grape-vine, most of them being polyphagous. The effect of damage to the vine during the different phases of its development is discussed, and a section on control measures is followed by details of the bionomics of the more important pests, with notes on their morphology and distribution in Russia and elsewhere. They comprise the two forms of *Phylloxera* [*cf. R.A.E.*, A **25** 661], the Tortricids, *Polychrosis botrana*, Schiff., *Clysia ambiguella*, Hb., and *Sparganothis pilleriana*, Schiff., the Zygaenid, *Theresimima* (*Procris*) *ampelophaga*, Bayle, the Melolonthids, *Polyphylla olivieri*, Lap., and *P. fullo*, L., the weevils, *Byctiscus betulae*, L. (*betuleti*, F.), and *Otiorrhynchus turca*, Boh., an unidentified Cecidomyiid that has not been injurious since it was studied in Transcaucasia in 1923 [**13** 216], *Pseudococcus citri*, Risso, the Jassid, *Erythroneura* (*Zygina*) *parvula*, Boh., and the mites, *Tetranychus* (*Epitetranychus*) sp. and *Eriophyes vitis*, Land.

[Karlash (K.).] **Карлаш (К.). Data on the Biology and Acclimatisation of the Chinese Oak Silkworm** *Antheraea pernyi* **Guér.-Mén.** [*In Ukrainian.*]—*Res. Ecol. terr. Anim.* no. 5 pp. 103–115. Kiev, 1938. (With Summaries in Russian pp. 113–114 and English pp. 114–115.)

In view of the proposed introduction into the Ukraine of the Saturniid, *Antheraea pernyi*, Guér., the larvae of which feed on oak and produce silk of good quality, observations on its biology were carried out in the laboratory and an insectary in the Province of Kiev in the summer of 1936. It was found that, owing to the rather low temperature that usually prevails at the end of April and beginning of May (a mean of 21·8°C. [71·24°F.] with a minimum of 12·65°C. [54·77°F.]), the emergence of the moths from the cocoons and the development of the resulting eggs are delayed. The adults emerged

from 15th May till 2nd June, the egg stage lasted about 3 weeks, and the larvae spun their cocoons at the beginning of August. The first generation adults began to emerge 20 days later. The development of the larvae of the second generation was protracted until the end of November, and most of them died in the fifth instar. It appears, therefore, that it would be impossible to obtain two generations during the summer in the Ukraine unless the emergence of the moths in the spring was accelerated and the hatching of the larvae adapted to the beginning of the vegetation of oaks.

[Treĭman (F. S.).] **Трейман (Ф. С.). The Number of Caterpillars hatched from Eggs of the Gypsy-moth and their Survival at an early Age, depending on the Feeding Conditions of the maternal Generation.** [*In Ukrainian.*]—*Res. Ecol. terr. Anim.* no. 5 pp. 117–144, 14 refs. Kiev, 1938. (With Summaries in Russian pp. 138–141 and English pp. 141–144.)

Experiments to determine the influence of the nutrition of the larvae of *Lymantria* (*Porthetria*) *dispar*, L., on the survival of the eggs and larvae of the subsequent generation were carried out near Kiev in the summers of 1935, 1936 and 1937. Larvae that were given abundant food invariably produced larger and heavier pupae than those that were given little, and the resulting adults laid larger egg-batches, in which the eggs were larger and heavier as well as more numerous. The average percentages of eggs that hatched in the case of large and small batches were 84 and 41·5, respectively, and there was a positive correlation of $0{\cdot}52 \pm 0{\cdot}10$ between the weight of the egg batches and the percentage of eggs hatching. The percentage mortality among the larvae in the first and second instars was not, however, apparently affected ; it averaged 49·5 and 50 in the offspring of poorly and well-fed parents, respectively. The total percentage of larvae that died was very high in both cases, as among the progeny only 0·7 and 1·07 per cent., respectively, gave rise to adults. The low rate of survival of the larvae from large batches of eggs may have been partly due to the fact that they were overcrowded and infected with flacherie. In larvae given the same amounts of food, the weight of the pupae was proportionate to the weight of the corresponding pupae in the preceding generation. Larvae subjected to prolonged and intense starvation gave rise to pupae of very light weight and adults that were sterile.

[Savitz'ka (Z.).] **Савицька (З.). The Dynamics of the Water and Fat in Insect Body in Connection with its Cold-resistance.** [*In Ukrainian.*]—*Res. Ecol. terr. Anim.* no. 5 pp. 145–160, 10 graphs, 1 ref. Kiev, 1938. (With Summaries in Russian p. 159 and English pp. 159–160.)

In experiments on the relation between the contents of water and fat in insects in different stages of development and their resistance to cold, the percentages of water and fat were determined in 147 individuals of *Lymantria dispar*, L., and in 151 of *Dendrolimus pini*, L. The rebound point (the point to which the temperature drops before it rises when the insect is frozen) was taken as the criterion of cold-resistance, and was determined for 112 individuals of *Lymantria* and 114 of *Dendrolimus*. The arithmetical mean for each stage was derived

from the data for the individual insects, and the coefficient of correlation between the rebound point and the percentages of water and fat in the body of the insect was calculated. It was found that the amount of water and fat in *L. dispar* affects its resistance to cold at all stages of development ; an increase in the amount of water lowers its resistance, whereas an increase in the amount of fat increases it. The best physiological indicator of cold-resistance in *L. dispar* is the logarithm of the fat percentage calculated for live weight, since this value yields the highest coefficient of correlation with the rebound point ($r=-0{\cdot}790$). In the case of *D. pini*, however, no relation could be traced between the content of water or fat and resistance to cold. It appears, therefore, that these physiological indices of cold-resistance are applicable only to certain species of insects.

[Emchuk (E. M.).] **Емчук (E. M.). Catalase Dynamics in** *Porthetria dispar* **and** *Dendrolimus pini* **during Development.** [*In Ukrainian.*] —*Res. Ecol. terr. Anim.* no. 5 pp. 161–180, 2 graphs, 25 refs. Kiev, 1938. (With Summaries in Russian pp. 177–178 and English pp. 178–180.)

With a view to determining the connection between metabolic activity and cold-resistance in insects, laboratory studies were made in the Ukraine on the cold-hardiness of all stages of *Lymantria* (*Porthetria*) *dispar*, L., and *Dendrolimus pini*, L., with parallel determinations of the catalase index, which is defined as the quantity of oxygen in cc. given off in 5 minutes per 100 mg. of live or dry weight of the insect. From the results obtained, which are shown in tables, it is concluded that the catalase index is a characteristic indication of the state of the organism under definite conditions, but that it is impossible to establish a direct relation between this index and the rebound or freezing points. In the case of the larvae of *L. dispar*, fed on apple leaves, a gradual lowering of the catalase index continues from the second instar onwards, and the rebound and freezing points rise, *i.e.* the resistance to cold is lowered. In the pupae, the catalase index and resistance to cold both increase. Young larvae of *D. pini* from the time of hatching till the third instar (in which they hibernate) exhibited a sharp rise in the catalase index accompanied by an increase in cold-resistance, but in the hibernating larvae the catalase index drops, while the cold-resistance increases greatly. After hibernation, there is a gradual reduction both in the catalase index of the larvae and their resistance to cold, but the connection is not so definite as in *L. dispar*. It is possible that the changes in the activity of the larvae in the spring and autumn are due to the difference in the quality of the food at these seasons. In the case of pupae, there is a slight increase in the catalase index and cold-hardiness.

In the adults of both species, particularly in males, the catalase index and cold-resistance are fairly high, though in nature the moths are never subjected to low temperatures. At the same time there is a decrease in the total quantity of water and an increase in the content of fat.

After cooling to a non-lethal level, the catalase activity increases in most cases, which has been verified for various stages. It is possible that after cooling or hibernation, a rise in the catalase activity sets in as a result of the intensification of the intercellular metabolism.

Further studies on the effect of the quality and quantity of food on *L. dispar* are desirable, as it was found that larvae feeding on oak leaves have a higher catalase index than those feeding on apple leaves, and that fasting larvae have a higher index than those that feed normally.

[Ivanov (S. P.).] **Іванов (С. П.). On the Significance of Cold Resistance Indices.** [*In Ukrainian.*]—*Res. Ecol. terr. Anim.* no. 5 pp. 181–195, 7 graphs, 23 refs. Kiev, 1938. (With Summaries in Russian pp. 194–195 and English p. 195.)

The following is substantially the author's summary: Various authors have proposed a number of indicators of cold-hardiness in insects, such as the contents of total and bound water, salts, fats, sugar, or catalase, but no sufficiently thorough study of the dynamics of their resistance to cold has been made. Furthermore, conclusions have been based on direct impressions gained from the data, without any estimate of their degree of reliability. The investigations of Savitz'ka and Emchuk [see preceding abstracts] have resulted in a sharp divergence in conclusions regarding two species of moths. In this connection, data published by the author and Savchenko [*R.A.E.*, A **25** 571] and by Sakharov [**17** 126] were subjected to critical examination. The employment of a more accurate procedure (calculating the correlation coefficients with an estimate of reliability by the formula for small numbers, constructing lines of regression, and taking logarithms of the independent variables) has shown that these data do not justify the conclusion that fat is an indicator of cold resistance. The total percentage of water is an indicator and so is the percentage of bound water; the latter (according to Sakharov's data) is not of greater significance than the former. All the data on cold-resistance indicators in the literature require critical verification.

[Tziopkalo (V. L.).] **Ціопкало (В. Л.). On the physiological Characteristics of Males and Females of the Cockchafer** (*Melolontha hippocastani* **Fabr.).** [*In Ukrainian.*]—*Res. Ecol. terr. Anim.* no. 5 pp. 197–209, 1 fig., 21 refs. Kiev, 1938. (With Summaries in Russian pp. 207–208 and English pp. 208–209.)

Investigations on the physiological processes in insects have been started in the Ukraine, as a knowledge of them may render possible improved methods of control and explain failures that may take place. Thus, observations have shown that male and female cockchafers (*Melolontha*) differ considerably in their reaction to poisons. Experiments were, therefore, carried out with three groups of adults of *M. hippocastani*, F., those dug out of the soil in the autumn, those taken in the spring at the beginning and middle of the flight period, and those taken at the end of it. The contents of water, glycogen and fat in beetles of each sex of each of these groups was determined, and the intensity of the gas exchange was studied. The results showed that males contain more water than females, and females with mature eggs contain least; that the maximum quantity of fat occurs in beetles in the autumn before hibernation, and that the vital processes during that period take place at the expense of fat; that in the spring the quantity of glycogen increases rapidly both in the males and

females, and the mass mortality of the beetles at the end of the swarming period cannot be explained by starvation in the absence of young leaves for feeding; and that the processes of metabolism are more intense in males than in females. As the males have a smaller reserve of nutritive substances and expend it more rapidly than the females, they are forced to feed more often and so are less able to survive unfavourable conditions when food becomes unsuitable for them, as in the case of foliage sprayed with poison.

[Efimenko (M. S.).] **Ефіменко (М. С.). Ueber die Nahrung der Kröten und Eidechsen, die in den Fanggräben der Zuckerrübenfelder nisten.** [On the Food of Toads and Lizards that inhabit Trap-ditches in Sugar-beet Fields.] [*In Ukrainian.*]—*Rep. zool. Mus.* no. 23 pp. 105–115, 4 refs. Kiev, 1939. (With Summaries in Russian pp. 111–113 and German pp. 113–115.)

In the Province of Kiev, the ditches containing trap-pits that are dug in spring round sugar-beet fields to catch the overwintered adults of the weevils, *Cleonus* (*Bothynoderes*) *punctiventris*, Germ., and *Tanymecus palliatus*, F. [*cf. R.A.E.*, A **24** 488] are often damaged by lizards and toads that fall into them and live in holes that they make in the sides. An analysis of the contents of the digestive tracts of 42 lizards, toads and frogs taken in ditches, of which *Lacerta agilis*, *Pelobates fuscus* and *Bufo viridis* were the most numerous, showed that they fed chiefly on small beetles, such as Elaterids and Carabids, and hardly at all on larger ones, such as *Cleonus* and *Tanymecus*, though the latter were abundant. It appears, therefore, that they are of no importance in the destruction of the chief pests of sugar-beet in trap ditches. Since, however, they are of much value in the open field, where they feed on a great variety of noxious insects, they should be collected and liberated in beet fields about the middle of June. The ditches should be kept in repair, and severely damaged trap-pits should be filled in and replaced by new ones.

Davis (J. J.). **The Necessity of a changing World.**—*J. econ. Ent.* **32** no. 1 pp. 1–10. Menasha, Wis., 1939.

The subjects discussed in this presidential address include the need for continuous entomological research, even on problems that have for the moment essentially been solved, the ways in which entomological problems are modified by changes in intensiveness of cropping, in cultural practices and in the crops and varieties grown, by legislative and regulatory requirements, by the raised standard of living and the more exacting demand of the consuming public, and by altered environment, government activity in insect control and the possible effect of political considerations, and the need for training suited to the new conditions.

Agencies utilized in disseminating Information on Insect Control.—*J. econ. Ent.* **32** no. 1 pp. 11–21. Menasha, Wis., 1939.

The papers comprising this symposium on extension work in the United States are: Commercial Agencies for disseminating Information on Insect Control, by T. H. Parks (pp. 11–13), in which the part that can be played by such bodies as manufacturers of

insecticides and spray machinery, wholesale and retail distributors of seeds and insecticides, canning companies, and officials of grain warehouses, local banks and railway companies is discussed ; Visual Instruction as an Agency for extending Entomological Information, by R. R. Reppert (pp. 13–15) ; Visual Aids and their Value in Entomological Extension Work, by G. E. Lehker (p. 15) ; Demonstrations for disseminating Entomological Information, by W. C. Nettles (pp. 15–17); The Use of Radio in Entomological Extension Work, by W. P. Flint (pp. 17–18) ; The Press for disseminating Entomological Information, by C. B. Dibble (p. 18) ; Can we adopt Uniform Methods for measuring Results in Entomological Practices ? by M. P. Jones (pp. 18–20), who concludes that the method of measuring results need not be the same for all practices, but that in order to determine the merits of various activities and justify the work to the public, results must be measured in some way ; and Human Characteristics we must observe in Entomological Extension Work, by A. B. Graham (pp. 20–21).

List (G. M.). **The Effect of Temperature upon Egg Deposition, Egg Hatch and Nymphal Development of** *Paratrioza cockerelli* **(Šulc).**— *J. econ. Ent.* **32** no. 1 pp. 30–36, 1 ref. Menasha, Wis., 1939.

The intermittent outbreaks in certain localities of *Paratrioza cockerelli*, Šulc, the most serious pest of tomatos and potatoes in Colorado, the severe injury it causes in the cool, high mountain areas and its frequent almost complete disappearance during the hotter part of the summer from some of the warmer areas indicate that it is especially affected by high summer temperatures. During the winter of 1935–36, studies were carried out on the effect of keeping the Psyllids at constant temperatures of 60–100°F., and at 80°F. with exposures to higher temperatures for a few hours each day. The optimum temperature for the species was found to be about 80°F. The effect of temperature upon oviposition, length of adult life, hatching and nymphal development are shown in tables. Oviposition began a day later at 70° than at 80°, but eggs were deposited quite freely at 70° and 60°. Very few eggs were laid at 90–100°. Adults kept at 90° for 9 hours and 80° for 15 hours oviposited more freely than those kept at 90°, but less freely than those kept at 80° ; others held at 100° for 9, 5 or 2 hours per day laid very few eggs. Exposure to constant temperatures of 90° or over and to 100° for a part of the day reduced the length of adult life considerably. In experiments on eggs deposited at 80°, exposure to 100° for only 1 or 2 hours daily or to 95° for 8 hours reduced the percentage hatch and the percentage of nymphs reaching maturity to less than 1 per cent. A temperature of 95° for 6 hours was not quite so detrimental. At constant temperatures of 60° and 90°, considerably fewer eggs hatched than at 80°, and nymphal development was even more seriously affected.

These results explain the almost complete disappearance of the Psyllid from the Grand Valley and the Arkansas Valley, Colorado, early each summer, the variability of infestation in the Fort Collins area, where heavy infestation does not usually appear until late August and September unless the season is a cool one, and the consistently heavy populations in the potato-growing areas at altitudes of 6,000 ft. or more, where the mean maximum temperatures are near the optimum for the species. It is thought that the spring infestation in the Grand Valley and probably other parts of Colorado comes from some distant

breeding ground through migration. Psyllids were taken in considerable numbers in traps operated in 1933–35 in the extreme west of known to be coming from southern Arizona, and were probably being the State, often in association with flights of *Eutettix tenellus*, Baker, carried by the same air currents. At the same time, the Psyllid largely disappeared from the southern breeding area.

HENSILL (G. S.) & TIHENKO (V. J.). **Mechanical and other Factors affecting Oil Spray Deposits.**—*J. econ. Ent.* **32** no. 1 pp. 36–40, 5 refs. Menasha, Wis., 1939.

As variation and irregularity in mechanical factors may affect the results obtained in experimental work on spray deposits from oil emulsions, attention is drawn to the advantages of using good quality measuring and weighing apparatus and of establishing a definite routine, and to the necessity for uniformity in the period of mixing, pressure and delivery, the period of exposure of the test objects to the spray, the slope or pitch of the nozzle, the diameter of the orifice of the nozzle and its distance from the test objects. Laboratory spraying equipment should be enclosed to eliminate the effect of wind. Ordinary temperature ranges do not affect deposit. Bees-wax was the most satisfactory of various artificial surfaces tested, but more oil per unit of area is deposited on natural surfaces, and these should be used when obtainable in sufficient quantity and uniform condition. The surface should be free from foreign material. The test objects should be allowed to dry for a uniform time ; 24 hours has been found the most satisfactory.

LAMIMAN (J. F.). **Pear Bud Injury and the Pear Leaf Blister Mite.**—*J. econ. Ent.* **32** no. 1 pp. 40–43, 5 refs. Menasha, Wis., 1939.

The injury caused by the bud form of *Eriophyes pyri*, Pgst. [*R.A.E.*, A **20** 584] has been observed for many years in California on pear trees that do not show blistering of the new foliage. In severe infestations, the fruit and terminal buds may turn brown early in the winter and become so dry that they drop off when touched. More commonly, the mites feed on the floral portions of the buds, which either fail to open, or open with one or two weak blossoms that fail to set or produce russetted or misshapen fruit. Subsequent feeding on the new growth does not do apparent damage unless the infestation is very severe. The mites begin to enter the terminal and leaf axil buds in June–August or as soon as the new growth begins to harden, and remain inactive under the outer bud scales until September or October, when they begin to work their way towards the centre of the bud. Oviposition takes place from September to June, and the young mites enter the floral portions of the buds. In the spring, the mites move out with the new growth, feeding on the fruit, in the axils of the leaves and at the growing tip until growth ceases. There are probably several generations a year. A comparison of the habits of the bud and blister forms of the mite is made in a table.

The spray of 2 per cent. summer oil and 5 per cent. lime-sulphur [*loc. cit.*], which must be applied after the pears are picked, but before the mites have worked deep under the bud scales, cannot be successfully used in areas where harvest is delayed until September. In such

areas, the addition of 5 lb. wettable sulphur to the calyx and first cover sprays applied for the control of the codling moth [*Cydia pomonella*, L.] adequately checked the development of the mite, and its numbers were considerably reduced where nicotine sulphate was added to the codling-moth sprays for the control of the pear thrips [*Taeniothrips inconsequens*, Uzel].

Bailey (S. F.). **The Six-spotted Thrips,** *Scolothrips sexmaculatus* **(Perg.).**—*J. econ. Ent.* **32** no. 1 pp 43–47, 1 fig., 28 refs. Menasha, Wis., 1939.

The mature larva, pupa and adult of *Scolothrips sexmaculatus*, Perg., are described, and records are given of its distribution in the world and within the United States and California, together with lists of some of the plants from which it has been collected and nine species of mites on which it is known to feed. It is most abundant in California from July to September, but is rarely found in large numbers and reproduces very slowly, so that its value as a predator is limited and there is little hope of its becoming important if artificially reared and liberated. Males and females are collected and reared in the ratio of 1 : 2. The females lay 4–5 eggs, which are inserted in tender leaves and shoots. The egg, larval, prepupal, pupal and adult stages last 6–10, 5–21, 1, 3–5, and 14–21 days, respectively. On plant food alone, the adult can live only 3 days. Larvae, pupae and adults are found together among the mites, and larvae and adults feed on adult mites as well as eggs. The population falls rapidly in October, and it appears that the winter is survived by a few adults only.

Campbell (R. E.) & Stone (M. W.). **Trapping Elaterid Beetles as a Control Measure against Wireworms.**—*J. econ. Ent.* **32** no 1 pp. 47–53, 2 figs. Menasha, Wis., 1939.

The following is almost entirely from the authors' summary : The habit of Elaterid beetles of gathering under débris was used in an attempt to trap adults of *Pheletes* (*Limonius*) *californicus*, Mann., in California as a control measure against the larvae. The trap, which was a pile of *Malva parviflora* or some other coarse plant, lost its attractiveness if it, or the soil underneath, became dry. Such traps attracted from 666 to 3,102 beetles per acre. During six years of trapping in a five-acre field, over 30,000 beetles were caught, but there was no apparent reduction in population. The use of adult emergence cages for two years showed that the number of beetles emerging in the fields far exceeded the number attracted to the traps. The traps attracted more females than males, and the females remained under the traps longer. Traps placed 150 ft. apart attracted more beetles than those 100 ft. apart, but more beetles were caught per acre in the latter as they were more numerous. Placing traps 50 and 75 ft. apart did not increase the proportion of beetles trapped. Of marked females liberated, 13–28 per cent. were recovered in the trap piles. Marked beetles of both sexes remained under the traps for 2–20 days, the number gradually decreasing throughout this period. From the results obtained during the investigations reported in this paper, it appears that piles of plant material as traps for adults of *P. californicus* cannot be used successfully as an aid to control.

MICHELBACHER (A. E.). **Seasonal Variation in the Distribution of two Species of Symphyla found in California.**—*J. econ. Ent.* **32** no. 1 pp. 53–57, 6 figs., 10 refs. Menasha, Wis., 1939.

An investigation to determine the cause of fluctuations in population of *Scutigerella immaculata*, Newp., was made in California in 1935. Soil samples were taken at intervals of about 1–2 months, and the water flotation method was used in examining them. The experimental field, which was fallow for some part of the year, was in an area with a very high water table, and samples were usually taken to a depth of 18 ins. in three equal parts. Samples were taken in pairs, when crops were growing; one sample was taken from the row and one from the space between the rows. In addition to *S. immaculata*, which was widespread, *Symphylella subterranea*, Michelbacher (1939), was found in the field studied, but nowhere else in the region. The two species varied greatly in their distribution and behaviour. *Scutigerella*, a very active species, was attracted to growing vegetation and was found in large numbers in the surface soil when plants were present and in the deeper soil when they were not. It was also influenced by moisture, temperature and soil structure, moving to deeper soil to escape excessive dryness or extremes of heat or cold and being always more abundant in loose than compact soil. *Symphylella* was much more sluggish and remained in deeper soil. It was not attracted to growing plants and probably feeds on fungi or humus. Population of both species is likely to be lowest in late winter and spring and highest in summer. The experimental field was flooded in late October, after which *Scutigerella* was difficult to find [*cf. R.A.E.*, A **26** 280], but *Symphylella* is better able to withstand flooding. The natural factors that materially reduce populations of *Scutigerella* in certain areas were not ascertained.

BROWN (G. T.) & HOSKINS (W. M.) **Factors concerned in the Deposit of Sprays. V. The Effects of pH upon the Deposit of the Oil and Water Phases of Oil Emulsions.**—*J. econ. Ent.* **32** no. 1 pp. 57–61, 2 figs., 12 refs. Menasha, Wis., 1939.

The following is mainly the authors' summary: The deposit of oil upon a standard bees-wax surface from emulsions containing sodium oleate or triethanolamine oleate is decreased by changing the pH from 2·5 to 5 and 5 to 7·5. Upon further changing the pH to 10, the deposit is greatly increased except when large amounts of the soaps are present. When haemoglobin is used, the oil deposit increases with the pH throughout the range, though only slightly when the pH changes from 7·5 to 10. With all three accessory substances, the total amount of oil emulsion deposited increases as the pH rises, except that when the soaps are present in large amounts it falls when the pH changes from 7·5 to 10. Attention is called to the importance of pH control in practical spraying.

WAMPLER (E. L.) & HOSKINS (W. M.). **Factors concerned in the Deposit of Sprays. VI. The Role of Electrical Charges produced during Spraying.**—*J. econ. Ent.* **32** no. 1 pp. 61–69, 3 figs., 13 refs. Menasha, Wis., 1939.

The following is practically the authors' summary: Electrical charges are produced on droplets by the rupture or atomisation of

liquid columns, as well as by impact and splashing of droplets against a surface. The rolling of droplets and sliding of films of liquid over surfaces also produce charges thereon. A small compressed air sprayer was developed for production of spray, delivering 400 cc. per minute at a pressure of 20 cm. mercury. Charges carried on droplets are given up to the sprayed surface, and if the latter is connected through a high resistance to the earth, a steady current and potential are established as long as the spray remains uniform. The potential has been measured by the use of a vacuum tube electrometer circuit. The voltage, V, can be given any magnitude by varying the input resistance, R, as is seen from the expression, $V=IR$. R remained fixed throughout at 13 megohms. Currents developed during spraying were on the order of 10^{-8} to 10^{-9} ampères. Spray droplet charge is directly proportional to spraying pressure and inversely proportional to electrolyte concentration. On sprayed bees-wax surfaces, charge varies greatly both in sign and magnitude, depending on the kind and amount of electrolyte present and upon the hydrogen-ion concentration of the spray. Wetting of the wax surface occurred when aluminium nitrate was present in certain concentrations in the spray suspension, but this wetting would not take place unless the pH of the solution was properly adjusted. A possible explanation of the manner in which the aluminium ion operates to produce wetting is given. When wetting occurred, the magnitude of the charge upon the sprayed surface decreased steadily as wetting progressed, and at complete film formation, the charge always reached a minimum value. This charge-wetting relationship held for several wetters of widely divergent chemical composition. Deposit of lead arsenate is related to degree of wetting, but not to charge upon spray droplets or sprayed surface. The results obtained when plant leaves were sprayed closely parallelled those with bees-wax surfaces. Retention of lead arsenate upon the bees-wax surface could not be increased by charging spray droplets and sprayed surface with external potentials of unlike sign, and wetting was likewise unaffected. Wetting controls deposit, and in its absence deposit is low. There is no relation between the deposit of lead arsenate and the total charge of the spray droplets or of the sprayed object.

Douglass (J. R.), Wakeland (C.) & Gillett (J. A.). **Field Experiments for Control of the Beet Leafhopper in Idaho, 1936–37.**—*J. econ. Ent.* **32** no. 1 pp. 69–78, 9 figs., 4 refs. Menasha, Wis., 1939.

Resistance to curly top in beet increases with age. The adoption in south-central Idaho of certain newly developed varieties that show appreciable resistance even as small seedlings rendered desirable experimentation, which had previously been thought useless, on the chemical control of *Eutettix tenellus*, Baker, the vector of the disease, in an attempt to protect the plants during their period of relatively low resistance, particularly in years when the percentage of infected leafhoppers in the spring brood was low [*cf. R.A.E.*, A **27** 286].

In 1936, 46 experiments were carried out, all with atomised sprays. In 44 of them, the sprays consisted of pyrethrum extract (containing not less than 2·0 gm. pyrethrins per 100 cc.) mixed with a light-medium summer spray oil and kerosene, or with kerosene alone, in ratios of oil to pyrethrum extract of 25 : 1 to 50 : 1. The other two sprays consisted

of oil containing 4 per cent. lauryl thiocyanate or 2 per cent. pyrethrum extract and 2 per cent. lauryl thiocyanate. The percentage mortality obtained by spraying ranged from 35·25 to 97·83. In general, it increased with the pyrethrum content of the spray, ratios of oil to pyrethrum of 25 : 1 and 30 : 1 giving better results than ratios of 40 : 1 and 50 : 1. It also increased as the rate of application per acre increased from 5 to 6, 6 to 7, and 7 to 8 U.S. gals. In 1937, atomised sprays of nicotine in oil and ordinary sprays of derris in water and nicotine sulphate in oil emulsion were tried also, but they were much inferior to pyrethrum extract in oil.

There was no significant difference between the amount of disease on the various treated plots and the untreated plots in 1936 or 1937, nor was there any correlation between the yield obtained and the spray applied. This was expected as the leafhoppers redistributed themselves over the field after each application. The disease developed much more quickly in a susceptible variety than in a resistant one, and the latter produced a fairly satisfactory yield under high infestation. In 1937, the average yields of the resistant and susceptible varieties were 12·6 and 0·64 tons per acre, respectively. The period from the beginning to the peak of the spring movement of *E. tenellus* from the desert to cultivated areas occupies 12–36 days, and the period of migration coincides very well with the period when the plants are most susceptible.

FLETCHER (R. K.) & GAINES (J. C.). **The Effect of Thrips Injury on Production in Cotton.**—*J. econ. Ent.* **32** no. 1 pp. 78–80. Menasha, Wis., 1939.

In 1934, an investigation was undertaken in Texas to determine the extent of loss of cotton attributable to thrips. The nature of the damage is described [*cf. R.A.E.*, A **24** 783; **27** 277, etc.]. An intensive study was made of severe injury in one field in which only *Frankliniella tritici*, Fitch, was present. When the cotton was chopped between 10th and 17th May, none of the plants was observed to be dead, but many died during the last fortnight of May. In a plot in the centre of the field, 64 per cent. of the plants were injured before picking. These produced 232 lb. seed cotton per acre, while the normal plants produced 332 lb. The loss per acre calculated from this is 358 lb. Bolls matured much earlier on normal than on injured plants, and 1 lb. seed cotton was produced by 118 bolls from normal plants and 134 from injured ones. In 12 bottomland fields on light, sandy and heavy soils, the percentages of plants injured varied from 10·67 to 57. The estimated loss in seed cotton per acre in these fields varied from 43 to 230 lb., with an average of 107 lb., and in 2 upland fields was 39 and 83 lb. The average numbers of bolls per plant produced on 324 normal and 192 injured plants were 5·73 and 4·56, respectively. The injured plants produced bolls 10–14 days later than the normal ones.

PYENSON (L.). **Notes on the Biology of the Cotton Pruner** *Chalcodermus bondari* **Marshall.**—*J. econ. Ent.* **32** no. 1 pp. 80–83, 4 figs., 5 refs. Menasha, Wis., 1939.

Chalcodermus bondari, Mshl., has been found damaging cotton throughout the state of Pernambuco, Brazil, as well as in Bahia [*R.A.E.*, A **15** 610] and as far south as the Chaco region in Argentina

[**23** 92]. Part of the original description [**15** 237] is quoted. The weevils pass the day in young leaf-clusters and in the folds of wilted leaves on the cotton plants or on the ground under leaves or other débris. In addition to the leaves, petioles and young green stems of cotton, wild malvaceous plants and *Croton glandulosus* are also attacked. The females make a ring of punctures in young shoots, petioles or flower stems and deposit an egg in the tissue just above it. The parts above the ring usually wilt and die, and young seedlings may be entirely killed. If the parts above the ring continue to grow no larvae develop in them. Females have been observed to oviposit 1–5 times in a single night. The egg stage lasts about 3 days. The young larva bores up the stem, and when that part is hollowed, down below the ring. When it is full-grown, 12–18 days later, it bores out and drops to the ground, where it constructs a cell at a depth of about 2–4 ins. and pupates after 4–5 days. The pupal stage lasts 6–7 days, and the adult remains in the soil for a further 5 days before becoming active. Oviposition begins when adults are about 3 weeks old. Injury appeared daily in a small isolated plot of cotton from 26th February to 6th April 1936, and again on 5th May. Under dry conditions, the larval period is prolonged. It is not certain whether there is a diapause in the dry season or continuous breeding in wild food-plants.

The writer has reared from *C. bondari* two females of a Braconid of the genus *Urosigalphus* near *chalcodermi*, Wlksn. [**19** 173], but thought to belong to an undescribed species, and an unidentified Chalcidoid [*cf.* **23** 92]. In laboratory tests, a 0·5 per cent. suspension of lead arsenate was not effective against the adults, but Paris green at the same concentration gave almost complete kill in 24 hours. Spraying or dusting for the control of *C. bondari* alone is too expensive, but treatment might be combined with that for other pests, such as cutworms. Early in the dry season, all cotton plants should be destroyed and the fields ploughed and left fallow, and all bushes and weeds in the immediate vicinity should be burnt.

VANCE (A. M.). **Occurrence and Responses of a Partial Second Generation of the European Corn Borer in the Lake States.**— *J. econ. Ent.* **32** no. 1 pp. 83–90, 1 fig., 2 refs. Menasha, Wis., 1939.

In north-eastern Indiana and a section of south-eastern Michigan and north-western Ohio where early sweet maize is grown, there has been an apparent increase in recent years in the proportion of *Pyrausta nubilalis*, Hb., producing two generations annually [*cf. R.A.E.*, A **25** 542]. In the parts of north-eastern Indiana surveyed in the autumns of 1936 and 1937, 5·7 and 28·1 per cent., respectively, of the larvae observed were sufficiently immature to indicate that they belonged to a second generation ; and near Toledo (Ohio), 6·2 and 8·7 per cent. of the larvae in early sweet maize surveyed in the summer of 1936 and 1937 pupated late in July and early in August and produced adults that oviposited during August. Pupation at this time near Toledo is closely related to the presence of early sweet maize ; there may be a direct relationship between the nutrients contained in sweet maize and early pupation. In the same locality in 1937, overwintered second-generation larvae pupated and gave rise to adults rather earlier than single-generation larvae.

Data from controlled experiments in the laboratory indicate that the second generation responds differently from the single generation to certain developmental conditions, and that the differences in response persist from one generation to another. When larvae collected early in November 1936 were immediately placed under conditions suitable for development, only a few pupated within 40 days, and single-generation larvae pupated rather sooner than second-generation ones. When larvae were placed under conditions suitable for development in the spring of 1937, however, pupation occurred within 30 days and was much earlier among second-generation than single-generation individuals. In the summer of 1937, 75·2 and 9·0 per cent. of the larvae arising from adults of the second and single generations of 1936, respectively, pupated within 40 days of hatching. After 40 days in an incubator, 79·3 per cent. of larvae from second-generation eggs collected in the field in August 1937, 95·2 per cent. of larvae from second-generation eggs laid in the laboratory and 3·1 per cent. of larvae that were the progeny of single-generation individuals of 1936 had pupated. When eggs laid by moths of the single and second generations of the previous year were placed on yellow dent maize, only 4·6 and 4·1 per cent. of the larvae, respectively, developed, and only one individual (0·6 per cent.) pupated. This larva belonged to the second-generation strain. It is thought that nutrition may have been the primary cause of the failure to pupate. The fact that no pupation occurred by the middle of November among immature and mature second-generation larvae collected on 15th and 23rd September 1937 and isolated on food in the incubator, indicates that the influence or influences inducing diapause had acted upon the physiology of the larvae before they were collected.

Environment and nutritional factors appear to influence the expression of hereditary characters both in the single- and two-generation forms, but little is known concerning their relative importance and effect in the inhibition or promotion of pupation, and the consequent result on numbers of generations annually. The widespread occurrence of a partial second generation in several of the Lake States indicates that the single-generation strain may be modifying its responses to environment and may now be in a state of transition towards a two-generation form, especially in the southern part of the area in Indiana in which it occurs.

SEARLS (E. M.). **Time of Fumigation of Aphid infested Canning Peas and Resistance of the Plants to subsequent Infestation.**—*J. econ. Ent.* **32** no. 1 pp. 90–93, 1 fig. Menasha, Wis., 1939.

Tests were carried out in 1937 on the extent of the resistance to *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) of susceptible strains of peas when approaching maturity. Four replicate groups of ten plots were used, all of which were infested on 29th July, 14 days after planting out, at the rate of one Aphid to 3 plants. The population of Aphids on each plot (expressed as the total number on 5 plants) was determined weekly, and all the Aphids on individual plots in each group were destroyed by fumigation 1, 2, 3, 4 or 5 weeks after the peas were infested. On the mornings following fumigation, the fumigated plots were reinfested at the same rate as the primary infestation. Before the count at the end of the seventh week, the plants on the untreated plot were destroyed by Aphids, of which the population was

nearly 600 at the end of the sixth week. The population on the plot that was fumigated at the end of the first week built up to nearly 500 by the end of the sixth week, and the plants were destroyed at almost the same time as those in the control plot. The plot fumigated at the end of the second week was about as susceptible as the two preceding ones, but as it had been fumigated a week later, it was possible to harvest the peas for canning before the plants were destroyed. The Aphid population on the plot fumigated at the end of the third week had increased to about 250 by the seventh week. The infestation that developed after fumigation on the plots treated at the end of the fourth and fifth weeks was practically negligible. It appears that if plants are freed of Aphids about four weeks before the date of canning, there will not be time for an infestation to reach destructive numbers before harvest.

On the untreated plots, there were many Aphids bearing wing pads by the third week when the blossom buds were appearing ; nearly all the young bore wing pads by the end of the fourth week, and nearly all the Aphids were winged by the end of the sixth week.

McLaine (L. S.) & Monro (H. A. U.). **Hydrocyanic Acid Gas in the Vacuum Fumigation of Broom Corn under Winter Conditions.**—*J. econ. Ent.* **32** no. 1 pp. 94–98, 9 refs. Menasha, Wis., 1939.

Investigations were carried out in Quebec in 1936–37 to determine whether, with the aid of pre-warming, broom corn [*Sorghum*] could be successfully fumigated against *Pyrausta nubilalis*, Hb., under winter conditions by the standard procedure, *viz.* introducing 2½ lb. hydrocyanic acid gas per 1,000 cu. ft. of tank space at a commodity temperature of 60°F. or over and a tank temperature of 90°F., after the evacuation of the tank has left an absolute pressure equivalent to 1¼–1½ ins. of mercury, thus leaving an absolute pressure of about 2½ ins. mercury [*cf. R.A.E.*, A **25** 775]. Larvae in bundles of test stalks stored at 33°F. for 1–4 days and then chilled at 10°F. for varying periods up to 21 days were all killed by fumigation for 3 hours by this method under commercial conditions, if previously warmed at not less than 50°F. for 24 hours. When the period of fumigation was reduced to 2½ hours, complete mortality was not obtained in one lot out of four. The highest mortality in any control was 6 per cent. Regular inspection of imported broom corn in warehouses 1–2 weeks after fumigation in this way revealed that the treatment had caused complete mortality in every shipment examined.

Cassidy (T. P.) & Barber (T. C.). **Hemipterous Insects of Cotton in Arizona : their economic Importance and Control.**—*J. econ. Ent.* **32** no. 1 pp. 99–104, 1 fig. Menasha, Wis., 1939.

As a result of tests that have been in progress since 1932, the identity of the species of Rhynchota responsible for the extensive staining of cotton in Arizona [*cf. R.A.E.*, A **27** 381] has been established. Of the 53 species known to be present, some of which are predators, only 15 have been shown to feed and breed directly on cotton, and most of the damage is caused by 8, *viz.*, the Pyrrhocorid, *Dysdercus mimulus*, Hussey, the importance of which has been greatly overestimated, the Pentatomids, *Euschistus impictiventris*, Stål, *Chlorochroa sayi*, Stål, and *Thyanta custator*, F., and the Capsids,

Lygus hesperus, Knight, *L. pratensis oblineatus*, Say, *L. elisus*, Van D., and *Creontiades femoralis*, Van D. All these puncture the bolls, with the result that the lint becomes stained by introduced pathogenic organisms and often the whole boll is valueless. The Pentatomids are the most important in this respect, but the Capsids also injure the terminal buds, causing malformation of the plant, and *Lygus* spp. and *C. femoralis* cause shedding of the young squares and small bolls. Punctured bolls are considerably more difficult to pick than uninjured ones. A survey of all the main cotton-growing sections of Arizona showed that in each of the four years 1934–37, about 25 per cent. of the bolls of upland cotton were punctured, the average percentage for the four years varying in different districts from 7·9 to 49·7. In the years 1935–37, the percentages of injured bolls of long-staple cotton averaged only 2·5–7·7.

Preliminary field experiments indicated that dusting with sulphur and arsenicals would give some control. In tests in small field plots in 1933, plots dusted 4 times with sulphur, calcium arsenate and lead arsenate at the rate of 14 lb. per acre per application yielded, respectively, 469, 384 and 297 lb. more seed cotton per acre than the control. In 1934, plots receiving 6 applications of sodium fluosilicate, lead arsenate, pyrethrum (0·58 per cent. total pyrethrins), sulphur, and derris (4 per cent. rotenone) yielded 517, 454, 328, 189 and 151 lb., respectively, more than the control. However, the soil was better in the plot treated with sodium fluosilicate than in the others. In 1935, plots receiving 9 applications of lead arsenate, Paris green and sulphur (1 : 14) or sulphur alone at about 10 lb. per acre per application yielded 523, 248 and 206 lb. per acre more than the controls. The increases from mixtures of derris and sulphur and pyrethrum and sulphur were considerably less, and sodium fluosilicate gave no increase. Results obtained in 1936 were not consistent or satisfactory. In 1937, there were experiments in three districts, which had low, moderate and heavy infestations, respectively. In the first two, the largest increases in yield per acre over the control were effected by sulphur (178 and 1,078 lb. or 11·2 and 98 per cent.) and in the third by mixtures of 1 part Paris green and 9 parts sulphur (2,691 lb. or 116·8 per cent.) and 1 part calcium arsenate and 2 parts sulphur (2,333 lb. or 99·9 per cent.), while sulphur gave an increase of 1,274 lb. or 55·5 per cent. It is recommended that applications be made at the rate of 15–18 lb. per acre, 5–6 weekly applications being sufficient for light infestations, but 6–9 being advisable for heavy ones. The cost of the treatment is discussed.

Moreland (R. W.) & Gaines (J. C.). **Insecticide Tests for the Control of the Bollworm in 1936.**—*J. econ. Ent.* **32** no. 1 pp. 104–106, 3 refs. Menasha, Wis., 1939.

Tests were made in Texas in 1936 of the comparative effectiveness of seven dusts for the control of *Heliothis armigera*, Hb. (*obsoleta*, F.) on cotton [*cf. R.A.E.*, A **27** 244, etc.]. The Latin square method of plot arrangement [**25** 428] was used, and the data obtained on yield were analysed by the method of analysis of variance. They indicate that calcium arsenate, calcium arsenate and Paris green (5 and 10 per cent.), calcium arsenate and cubé (0·8 per cent. rotenone) and calcium arsenate and sulphur (1 : 1), which were all applied so that plots received 7·76–9 lb. calcium arsenate per acre, were equally effective.

A mixture of calcium arsenate and lime (1 : 1) applied at the rate of 7 lb. calcium arsenate per acre was significantly less effective than calcium arsenate and Paris green (10 per cent.) or calcium arsenate alone applied at rates of 8·1 and 9 lb. calcium arsenate per acre, respectively. Pyrethrum dust (0·09 per cent. pyrethrins I and II) with sulphur as a carrier was not effective.

Becker (W. B.). **Larval Development of the Native Elm Bark Beetle, *Hylurgopinus rufipes* (Eich.), in Massachusetts.**—*J. econ. Ent.* **32** no. 1 pp. 112–121, 13 figs., 10 refs. Menasha, Wis., 1939.

The following is substantially the author's summary : The count of cast larval skins in several completed galleries of *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., indicated that there may be a variation in the number of stadia. The results obtained, however, by plotting on graphs the size distribution of the head-widths of one generation of larvae, which were collected at approximately weekly intervals, indicated that five stadia occurred most commonly under the conditions of the experiment. The results also indicated an overlapping in the sizes of the head-widths of successive larval instars and allowed for a variation from this number for some individuals. In addition, as the sexes are almost equal in number and there is a difference in the size distribution of the head-widths of the male and female adults, the data suggested that a difference in size distribution due to sex may begin to be noticeable in the last two larval instars.

Gibson (K. E.). **Wireworm Damage to Potatoes in the Yakima Valley of Washington.**—*J. econ. Ent.* **32** no. 1 pp. 121–124, 1 fig., 7 refs. Menasha, Wis., 1939.

As complete control of wireworms, which are among the major insect pests of potatoes in the United States, is often impossible under field conditions, an investigation was made in Washington in 1932 and 1933 in 27 potato fields where the only injurious species were *Pheletes* (*Limonius*) *canus*, Lec., and *P.* (*L.*) *californicus*, Mann., to determine whether any correlation existed between population and degree of injury. Though damage did not increase regularly with population, there was a general trend towards an increase. Total damage was usually less than 25 per cent. of the crop by weight where the wireworm population per sq. ft. was less than 0·5, and between 25 and 50 per cent. where the population was 0·5–1·0. It was nearly 60 per cent. at a population of 2, and rose slowly from this point to just over 80 per cent. as the population approached 7·6. Heavy damage showed a consistent and steady increase, but light damage, including 1 and 2 entrance holes per tuber, increased very rapidly, reaching a peak when the population was about 0·8. A curve drawn through points determined by arranging the fields in 6 groups shows a regular increase in damage corresponding very well with the average increase in population. A comparatively large amount of damage is done by a small number of wireworms, and the damage increases rapidly as population increases to about 0·96 per sq. ft., after which it is much more gradual. Date of planting, method of irrigation and variation in the type of soil, especially in its capacity for holding water, probably have a considerable effect on the extent of damage caused by a certain population.

LATTA (R.). **Observations on the Nature of Bulb Mite Attack on Easter Lilies.**—*J. econ. Ent.* **32** no. 1 pp. 125–128, 5 figs. Menasha, Wis., 1939.

Studies were begun in 1935 on the causes of injury to Easter lilies (*Lilium longiflorum*) by the bulb mite, *Rhizoglyphus hyacinthi*, Banks, and on methods of control. In repeated trials in which bulbs carrying a moderate natural infestation were forced and large additional populations introduced, the colonies of mites decreased to small numbers and the plants developed normally without injury. Dormant lily bulbs from Japan, examined at Seattle (Washington), were generally but lightly infested with mites, and characteristic, small feeding pits were found on the scales of all bulbs whether live mites were present on them or not. Immersion of dormant bulbs, immediately before potting or forcing, for 30 minutes in water at 110°F., or vapour-heat treatment at the same temperature for 60 minutes, caused complete mortality of the mites and apparently did not affect flowering.

Examination of many thousands of lily plants in commercial greenhouses revealed a definite association between serious mite injury to the stems and a lack of development of the stem roots. The area most favoured by the mites for feeding is the point of origin of the stem roots. Stems with normal brace roots were tough and fibrous, whereas stems lacking roots were usually brittle. Stems without external signs of attack often had mite tunnels, but these were never extensive enough to be injurious when stem roots were normal. Sometimes outer scales were almost entirely consumed on plants with normal stems and roots, but in this case injury did not advance inwards. The failures that occur each year among lilies are usually attributed to injury by mites. Examination of a batch that had failed showed that mite injury was externally evident on 80 out of 555 plants that were subnormal with 30–40 per cent. of the expected number of flowers, and these of poor quality. However, the basal roots of all were in poor condition, and the brace roots were lacking on the 80 plants that had injured stems and were decidedly subnormal on the remainder. As infestation by mites appears to be almost universal, it is apparent that some factor other than their presence or absence limits injury to a small proportion of the plants. It is thought that mite injury on stems is secondary to an unknown plant disorder.

SIEGLER (E. H.), MUNGER (F.) & SMITH (L. E.). **Toxicity to the Codling Moth Larva of Derivatives of Benzene containing Halogen and Nitro Groups.**—*J. econ. Ent.* **32** no. 1 pp. 129–131, 1 ref. Menasha, Wis., 1939.

In view of the effectiveness of *p*-iodonitrobenzene in experiments against *Cydia* (*Carpocapsa*) *pomonella*, L. [*R.A.E.*, A **25** 188; **26** 576], the toxicity of several benzene derivatives in sprays was tested by the apple plug method. With *p*-iodonitrobenzene, *m*-iodonitrobenzene, *p*-bromonitrobenzene and *m*-dinitrobenzene, 0·0, 16·7, 27·3 and 39·2 per cent. of the plugs, respectively, were infested, and with lead arsenate 31·5 per cent. With all other benzene compounds, over 50 per cent. of the plugs were infested. No marked correlation was shown to exist between either the groupings involved or their relative position. In further tests on the residual effectiveness of *p*-iodonitrobenzene, all larvae were killed when the apple plugs were exposed one

day or less after the application of the spray, but the percentage of stung fruit was high; when the plugs were exposed 5–6 days after spraying, more than 50 per cent. were infested in every case.

Johnson (G. V.) & Fenton (F. A.). **Control of the Flatheaded Apple Tree Borer in Oklahoma.**—*J. econ. Ent.* **32** no. 1 pp. 134–142, 9 refs. Menasha, Wis., 1939.

During 1937, experiments on the control of *Chrysobothris femorata*, Ol., consisting of cage toxicity studies, field and laboratory tests with repellent paints and field tests with fumigant paints and tree wraps were carried out in Oklahoma. The data obtained in toxicity tests were not conclusive because of the small number of beetles used. Lead arsenate was most effective at the rate of 6 lb. per 50 U.S. gals. water, higher concentrations showing a repellent effect. However, it is thought that spraying a small area will not protect the trees, as the beetles are extremely active. Formulae are given for 16 repellent paints, all of which were tested. In cage tests, branches painted with a mixture of potash fish-oil soap, flour, naphthalene and water [*cf. R.A.E.*, A **11** 546] had practically as many beetles on them as the control. A mixture of liquid lime-sulphur, hydrated lime and water seemed definitely attractive on account of its white colour. A tar-distillate emulsion (prepared by dissolving 1 lb. sodium carbonate in 1 U.S. quart hot water and emulsifying it with 1 U.S. quart carbolineum avenarius) showed a marked repellence, whether used alone or diluted with 2 U.S. quarts water. In tests on growing apple trees, however, repellent paints applied too late to prevent infestation greatly reduced the percentage of borers parasitised. Further tests were made on branches of apple and black walnut [*Juglans nigra*] painted with repellents and fastened in cans of water to pecan trees in an infested grove. Walnut became more heavily infested than apple exposed at the same time. The branches were exposed for 3 days when population was high and 5–7 days later in the season when it was lower, and were examined after 20–25 days. Repellents containing creosote, paradichlorobenzene or carbolic acid with and without Paris green injured the bark of both apple and walnut. In general, the number of borers was reduced more on walnut than on apple. Creosote gave good protection, and if prepared in the form of an emulsion, might not be injurious. Paraffin wax was nearly as effective alone as with paradichlorobenzene and did not injure the wood. Preparations containing naphthalene were very effective on walnut, but only moderately so on apple. Repellents containing lime tended to scale off easily. The preparations meriting further investigations were the one composed of potash fish-oil soap, flour, naphthalene and water, the diluted tar-distillate emulsion, and one consisting of paraffin wax applied while liquefied.

Four preparations were tested as fumigants to kill the borers while under the bark, but all were ineffective. There was very little difference between the effectiveness of five different kinds of paper wraps, which were tested on young elm trees. All were applied from the bottom upwards, 50 per cent. overlap being allowed. It is assumed that trees that died during the experiment were killed by *C. femorata*. Protecting the trunk by wrapping reduced the percentage of trees killed from 47·6 to 28·9–36·1. Wrappings tended to rot away at the bottom of the tree. Had they been repaired as they did so, the

number of trees saved would probably have been greater. Wrapping did not reduce the infestation of the trees that remained alive. The totals of trees killed or infested indicated that wrapping the trunk up as far as the first branches does not protect the tree adequately, as the beetles oviposited on the limbs above the wrappings. The branches should be wrapped as well as the trunk.

WITMAN (E. D.), WATERS (H. A.) & ALMY (E. F.). **Basic Copper Arsenate—A new Insecticide. I. Chemical and Physical Studies.** —*J. econ. Ent.* **32** no. 1 pp. 142–144. Menasha, Wis., 1939.
WATERS (H. A.), WITMAN (E. D.) & DELONG (D. M.). **II. Insecticide and Phytotoxicity Studies.**—*T.c.* pp. 144–146.

The physical and chemical properties of basic copper arsenate, which is proposed as an insecticide and fungicide, are given in the first paper. It is very insoluble in water, not subject to hydrolysis and only insignificantly affected by carbon dioxide. It is a definite crystalline chemical compound capable of being prepared in various particle sizes with uniformity, crystals of about 1–3 microns in length having been found to give the optimum results. It is compatible with lime at ordinary temperatures, with calcium caseinate, blood albumen, sulphur, Bordeaux mixture and sodium chloride solutions. It is decomposed by liquid lime-sulphur, but much more slowly than acid lead arsenate.

The second paper contains a summary of experiments conducted in the laboratory and in the field in Ohio on the toxicity of basic copper arsenate to various insect pests. At the rate of 1 lb. per 100 U.S. gals. water, it gave complete control of larvae of *Epilachna varivestis*, Muls., on beans in 24 hours, but 3 lb. per 100 U.S. gals. was needed to control the adults. All larvae of *Leptinotarsa decemlineata*, Say, on potato were killed in either 1 or 2 days with 1, 2 or 3 lb. to 100 U.S. gals. water, and 50 per cent. of the adults were killed with 3 lb. per 100 U.S. gals. A dust containing 25 per cent. basic copper arsenate gave excellent control of both species, and the addition of sulphur for the control of *Empoasca fabae*, Harr., on potato did not decrease its effectiveness. The median lethal dose of basic copper arsenate for last-instar larvae of *Xylomyges* (*Prodenia*) *eridania*, Cram., was found to be 0·18–0·20 mg. per gm. body weight, while that of acid lead arsenate is 0·25–0·28 mg. These data indicate that the toxicity of the two materials is approximately proportional to their respective arsenic pentoxide content (40·6 and 30·0 per cent., respectively). Last-instar larvae of *X. eridania* with a body weight of 400 to 500 mg., caged individually with access to bean leaves dusted with basic copper arsenate, and others with access to leaves dusted with lead arsenate, at 0·06 mg. per sq. cm., were all dead within 48 hours. Larvae given access to leaves treated with lead arsenate stopped feeding first and consumed less, but did not die until the second day. Those feeding on leaves treated with basic copper arsenate fed for about an hour longer, consumed more and were dead within 24 hours. Apparently, the initial effect of basic copper arsenate is slower than that of lead arsenate. This is a desirable property for the control of gross feeding insects, especially adult beetles, as it increases the chances of a toxic dose being consumed before the poison takes effect. Basic copper arsenate at the rate of 3 lb. to 100 U.S. gals. gave complete control of larvae of *Hyphantria cunea*, Dru., and *Ceratomia catalpae*, Boisd., in 48 hours. Experiments with

basic copper arsenate for the control of *Empoasca fabae* failed to show any toxicity, but it had considerable repellent effect. C. O. Eddy and co-workers obtained excellent control of larvae of *Anticarsia gemmatalis*, Hb., on soy bean in Louisiana with basic copper arsenate dust in 1938, and found that the median lethal doses for them both of it and of cryolite were 0·18 mg. per gm. It gave as good initial control as cryolite in the field, and better residual control.

Basic copper arsenate can be applied without causing foliage injury at all temperatures and humidities normally met with in the field to most types of plants, with the exception of stone fruits, which are apparently affected by all copper materials. Bean foliage, which is particularly sensitive to arsenical injury, can be sprayed with basic copper arsenate and placed in a fog chamber for 72 hours without visible injury. In laboratory tests with cultures of bitter rot and brown rot fungi of apple on agar media, basic copper arsenate proved more effective than basic copper sulphate or 4 : 4 : 50 Bordeaux mixture.

Hockenyos (G. L.). **Laboratory Evaluation of Soil Poisons used in Termite Control.**—*J. econ. Ent.* **32** no. 1 pp. 147–149. Menasha, Wis., 1939.

A simple method of evaluating termite soil poisons in the laboratory is described, and a few characteristic results are given. The method consists of pouring 40 gm. soil into glasses containing crumpled tissue paper and 15 cc. water. The glasses are 3½ ins. high and have an inside diameter of 2 ins. at the top and 1½ ins. at the bottom. The poison is added to either the soil or the water before they are put together. When the soil is thoroughly moist, 15–25 worker termites are placed on the surface. The termites invariably entered the soil in the control glasses in a few hours. Trichlorobenzene and polychloropentane were shown to be much superior to the orthodichlorobenzene now commonly recommended. Sodium arsenite and sodium arsenate were the best of the inorganic compounds tried. Sodium pentachlorphenate was highly toxic and repellent, but seemed to be easily removed from its water solution by the soil.

Romney (V. E.). **Breeding Areas of the Tomato Psyllid,** *Paratrioza cockerelli* **(Šulc).**—*J. econ. Ent.* **32** no. 1 pp. 150–151, 1 ref. Menasha, Wis., 1939.

Paratrioza cockerelli, Šulc, normally breeds from January to May on *Lycium andersoni* and *L. macrodon*, which occur in the semi-desert areas of southern Arizona below 3,000 ft. The population reaches its peak in late April or early May, and the adults move from the breeding ground by the middle of June and are not seen there again until late October or November. The food-plants normally shed their leaves in May owing to lack of moisture. A Eulophid parasite, *Tetrastichus* sp., attacks the nymphs, and numerous Coccinellids and Chrysopids prey on the eggs and nymphs to a varying extent from year to year. Data from insect traps in the Grand Valley of western Colorado indicated that the Psyllids infesting this district may come from southern Arizona [*cf. R.A.E.*, A **27** 409]. East of the Rockies, *P. cockerelli* and a closely related species, *P. mexicana*, Klyver, occur together in varying proportions, but the latter species apparently does not occur west of

the mountains. This would indicate that the infestations on the west have a different source. Both species breed on *Lycium* in Texas. It is possible that this is the main source of spring infestations east of the Rockies as far north as Colorado.

PLANK (H. K.). *Peregrinator biannulipes* **Montr., a Predator of the Bamboo Powder-post Beetle in Porto Rico.**—*J. econ. Ent.* **32** no. 1 p. 151. Menasha, Wis., 1939.

Numerous nymphs of a small bug found in association with *Dinoderus minutus*, F., infesting bamboos stored in a shed in Porto Rico in the autumn of 1936, and some of which were seen to attack the beetles, were reared to the adult stage on *D. minutus* and identified as *Peregrinator biannulipes*, Montr. & Sign. This is thought to be the first record of this Reduviid in Porto Rico and the first note of its feeding on a Bostrychid [but *cf. R.A.E.*, A **23** 90]. When placed in a tube containing several individuals of *D. minutus*, a nymph or adult of *P. biannulipes* almost immediately seized one and began feeding by inserting the stylets between the prothorax and mesothorax. The beetle soon died, and the predator fed for about 30 minutes and then attacked another beetle. The individuals that were reared took 7 months to develop from small nymphs to adults, and the adults lived for several months. Although *P. biannulipes* was found in considerable numbers during the autumn and winter, it exercised no appreciable control.

STAHLER (N.). **A Disease of the Corn Ear Worm,** *Heliothis obsoleta* **(F.).**—*J. econ. Ent.* **32** no. 1 p. 151. Menasha, Wis., 1939.

Laboratory rearing of *Heliothis armigera*, Hb. (*obsoleta*, F.) in California has been complicated in recent years by a larval disease causing usually not less than 10 and sometimes as much as 100 per cent. mortality. An infected larva acquires a metallic lustre, ceases to feed, becomes paralysed and dies in 1–3 days. When it dies, the cuticle blackens and becomes soft and sticky and can be pulled apart by slight tension, allowing the liquefied contents to flow out. The symptoms are those of a wilt disease, but no polyhedral bodies have been seen. The disease first attacked larvae in the sixth instar, then progressively younger ones in succeeding generations, until it became difficult to rear them beyond the third instar. No first-instar larvae and few of the second instar have been observed to die of the disease. Mortality is higher on lettuce or lucerne than on tomato fruit or maize meal.

SEATON (L.). **A Feeding Record of** *Pterostichus* (*Poecilus*) *chalcites* **(Say) upon June Beetle Eggs and Grubs.**—*J. econ. Ent.* **32** no. 1 pp. 151–152. Menasha, Wis., 1939.

Carabid larvae and adults have been commonly found during several years in soil containing white grubs [*Lachnosterna*] in southern Wisconsin. A single Carabid that was collected late in June 1938 and became adult on 18th July, and which was later identified as *Pterostichus* (*Poecilus*) *chalcites*, Say, consumed a total of 126 eggs and 2 first-instar larvae before 25th August, when the supply of eggs

and grubs failed and it was killed for determination. In most cases, all the food supplied was consumed. This feeding record suggests that Carabids are of great importance in the control of white grubs.

FLANDERS (S. E.). **A Black Scale Parasite with promising Qualities.**—*J. econ. Ent.* **32** no. 1 p. 152, 1 ref. Menasha, Wis., 1939.

An Encyrtid of the genus *Diversinervus*, introduced into California in 1937 for the control of *Saissetia oleae*, Bern., on *Citrus*, was reared and liberated in large numbers in 1938. Its development is synchronised with that of the Coccid, which depends on external conditions. In a rapidly developing host, the eggs, which are deposited in the large fused nerve ganglion, hatch in 10 days. The first larval instar is spent within the body ganglion, and its development is correlated with that of the host, as regards both time and size. When the host becomes mature and contains fully developed eggs, the larvae break out of the ganglion and moult to the second instar. They then pass rapidly through three instars. If 5 or more are present in a Coccid, it is prevented from ovipositing and the entire contents are consumed. The length of the pupal stage depends on the temperature, being almost the same as the incubation period at equal temperatures. No other parasite of *S. oleae* is known to have a life-cycle dependent on that of the host. *Diversinervus* will oviposit in several species of Coccids, but has not been observed to complete its development in any host other than *S. oleae*. It was one of the least abundant of parasites reared from shipments of *S. oleae* from Africa, but possesses certain characteristics that are thought to increase its ability to find hosts at low densities. It is robust, can fly over a considerable distance and is long-lived ; a single host usually yields both sexes, thus insuring pairing ; and oviposition is slow, a female sometimes ovipositing in 100 hosts over a period of several months. It will oviposit in nearly all stages of the Coccid. For maximum efficiency, 5–25 individuals should develop in a host. When the host population is dense, so few eggs may be deposited in a single host that reproduction is not entirely inhibited and the larvae develop in unfavourable conditions because of excess host fluids.

WOLCOTT (G. N.). *Prophanurus alecto* **Crawford in Porto Rico.**—*J. econ. Ent.* **32** no. 1 pp. 152–153. Menasha, Wis., 1939.

In 1921, an almost black parasite was reared from eggs of *Diatraea saccharalis*, F., in Porto Rico and was identified as *Telenomus* (*Prophanurus*) *alecto*, Crwf. Eggs of *Diatraea* collected about a month later also proved to be parasitised only by it. It was not again observed in Porto Rico until October 1938, when, in two localities in the north-west of the Island, a small black adult parasite was observed resting on an egg cluster in a sugar-cane field. All the egg clusters collected from this part of the Island were kept until parasites emerged, and it was found that only *Telenomus* was present at these two localities (16 and 14 per cent. parasitism), both *Telenomus* and *Trichogramma minutum*, Riley, at a third (50 per cent. parasitism) and *Trichogramma* only at a fourth (37 per cent. parasitism). A month later, no parasitised egg clusters could be found in the fields previously examined except in the last locality, where there was 25 per cent. parasitism by *Trichogramma*. It appears that *Telenomus* usually develops on some other as yet undetermined host.

Boyce (A. M.) & Persing (C. O.). **Tartar Emetic in the Control of Citrus Thrips on Lemons.**—*J. econ. Ent.* **32** no. 1 p. 153, 1 ref. Menasha, Wis., 1939.

Promising results were obtained in tests conducted during 1937 and 1938 on the use of tartar emetic (potassium antimony tartrate) for the control of *Scirtothrips citri*, Moult., on lemons in California. Tests in 1937 with sprays of 4 lb. tartar emetic per 100 U.S. gals. alone and with 8 lb. cane sugar showed that it was not effective without sugar. As this thrips usually avoids the blossoms of *Citrus*, the effect of the sugar in the spray is probably due to its being hygroscopic and not to its sweetness. Brown sugar, molasses and glycerine were all found effective substitutes for cane sugar; glycerine was tried, as sugars may furnish a substratum for sooty moulds. Promising results were also obtained in the field with certain dust mixtures of tartar emetic and sugars, glycerine, etc. Tartar emetic sprays caused slight foliage injury, particularly where there was a deposit of sulphur on the leaves, but no injury was observed to follow the application of dusts. Sprays of magnesium sulphate, phenothiazine [thiodiphenylamine] and cryolite, alone and with sugar, were not effective, but nicotine sulphate with molasses showed promise.

Kerr jr. (T. W.). **Lead Arsenate as a possible Control for the White Grub in Strawberries.**—*J. econ. Ent.* **32** no. 1 p. 153. Menasha, Wis., 1939.

In experiments in western New York during 1938, the application of mixtures of lead arsenate and sand to the roots of strawberry plants for the control of larvae of *Lachnosterna* (*Phyllophaga*) spp., which killed 45 per cent. of the plants on untreated plots, reduced the percentage of plants killed to 2. When magnesium arsenate and sand, suspensions of mercurous chloride (calomel) and gum arabic, and ground glass were used, 15–48 per cent. of the plants were killed. Treatment with calcium arsenate and sand resulted in total loss of the plants.

Marcovitch (S.). **Magnesium Oxide as a " Corrective " for Cryolite Sprays.**—*J. econ. Ent.* **32** no. 1 pp. 153–154. Menasha, Wis., 1939.

In 1938, magnesium oxide, which had been reported to be capable of removing small amounts of fluorides from water supplies, was tested as a " safener " for fluorine compounds used as insecticides. The foliage of smartweed [*Polygonum hydropiper*] is very susceptible to injury by Dutox (barium fluosilicate), but practically no injury to it resulted from the application of a dust of equal parts of Dutox and magnesium oxide. In a spray for use on apples, composed of 4 lb. copper sulphate, 1¼ lb. hydrated lime, 6 lb. magnesium oxide, 4 lb. cryolite and 100 U.S. gals. water, the magnesium oxide reduced copper injury and made the Bordeaux mixture formed by the copper sulphate and lime compatible with the cryolite. The addition of 16 lb. magnesium oxide per 100 U.S. gals. water to 4 : 4 : 50 Bordeaux mixture prevented defoliation of peaches.

Marcovitch (S.) & Stanley (W. W.). **Wool Grease or Degras as a Substitute for Mineral Oil in Sprays.**—*J. econ. Ent.* **32** no. 1 p. 154. Menasha, Wis., 1939.

In 1937 and 1938, 1 per cent. wool grease was tested as a substitute for summer mineral-oil emulsions on apple, peach, bean, tomato and tobacco, and no foliage injury was observed. Wool grease is rather difficult to emulsify, but a good emulsion was obtained by dissolving the warmed grease in an equal volume of kerosene and using 2 oz. blood albumen per U.S. gal. grease as the emulsifying agent. It did not appear that 3–6 per cent. wool-grease emulsions were toxic to eggs of the codling moth [*Cydia pomonella*, L.], but the addition of 3 per cent. crude naphthalene increased the ovicidal effect. A 2 per cent. emulsion of wool grease seemed to be effective against mites (red spider), and 1 per cent. added to copper fungicides appeared to prevent copper injury to foliage.

Holloway (J. K.). **An Agar Preparation for feeding Adult Parasite Insects.**—*J. econ. Ent.* **32** no. 1 p. 154. Menasha, Wis., 1939.

During work on parasites of the oriental fruit moth [*Cydia molesta*, Busck], a semi-solid food with an agar base was developed for the feeding of the adult parasites. It was solid enough to prevent them from fouling themselves, thus avoiding high mortality with certain species. It gave excellent results both in rearing cages and shipping containers, but experience in different regions indicated that the food prepared according to the original formula tended to liquefy at relative humidities of 50 per cent. or more. Consequently, tests were made to determine the best composition for use under varying conditions. It is recommended that 50 cc. agar solution and 25 cc. honey should be used at relative humidities up to 40 per cent., and that 10 and 25 gm. granulated sugar should be added at humidities of 40–70 and 50–90 per cent., respectively. The agar is added to water in the required amount to make a 1 per cent. solution and is dissolved by heating, the sugar is then added and finally the honey.

Knowlton (G. F.). **The Asparagus Beetle in Utah.**—*J. econ. Ent.* **32** no. 1 pp. 154–155. Menasha, Wis., 1939.

The asparagus beetle, *Crioceris asparagi*, L., occurred in destructive numbers in Utah during 1938. One field of asparagus in the north-west had been damaged by it in 1937, and it was probably introduced into the State not later than 1935. On 3rd May 1938, asparagus fields were examined and, although the day was cold, 1–50 adults were found on and in the sandy soil surrounding individual shoots in one field, and there were also large numbers of eggs. Some of the more important asparagus-growing areas of Utah had not become infested by the end of the growing season. Uncultivated asparagus along ditch banks, roadsides and in orchards facilitated the spread of the beetle in the infested area. Heavy mortality of larvae and adults followed applications of strong sprays of lead arsenate to which miscible oil had been added and of a dust of calcium arsenate and lime (1 : 3). Sprays of derris or cubé containing 4 per cent. rotenone and at the rate of 3 lb. to 100 U.S. gals. water with a wetting agent also gave good control, and cubé and derris dusts containing 1 per cent. rotenone usually gave satisfactory kills.

Walton (R. R.) & Fenton (F. A.). **Notes on *Empusa grylli* in Oklahoma.**—*J. econ. Ent.* **32** no. 1 pp. 155–156. Menasha, Wis., 1939.

In July 1938, it was reported that large numbers of grasshoppers in Oklahoma were being killed by a disease, the effect of which was typical of that caused by *Empusa grylli*, except that no fine, furry growth appeared on the outside of the body. All attempts to produce external conidia by placing the dead host in a moist bell jar were unsuccessful at temperatures of 50, 70, 80 and 90°F., but W. W. Ray was able to cause the appearance of the external fungous growth by experiments to be reported later, and the fungus was identified as *E. grylli*. Heavy rainfall greatly increased the rate of mortality caused by the disease. To check the apparent correlation, the edge of a lucerne field was selected, and grasshoppers that had died in the characteristic position, high on the plants, were collected from it each day between 15th July and 1st September ; the daily mean temperature and the rainfall were taken from the records of a weather station $2\frac{1}{2}$ miles away. On 15th July, the grasshopper population was about 10–12 per sq. yard. It remained fairly stable and during the last week of August was estimated at 8–10 per sq. yard. The number of grasshoppers dying during a single day never exceeded about 2·5 per cent. of the population. During the period, there were 8 days that had rain, 7 of which were grouped into 3 rainy periods, and there were 3 main peaks in the mortality rate, occurring 3–5 days after the beginning of each of the wet periods. Of 20 healthy grasshoppers confined individually for 12 hours in a pill box with an infected one dying of the disease, none had died of the disease or contained spores in its body at the end of 5 days. When the dying grasshoppers were replaced by individuals that had been dead one day, 2 of the 20 healthy ones died of the disease after being exposed. When 20 healthy grasshoppers were kept in a cage containing bran liberally moistened with a suspension of the hyphal bodies and spores in distilled water, 5 died of the disease within 6 days. The other 15 appeared healthy, but all contained spores in the intestinal tract. Since no external conidia were developed, it would seem that the disease may be transmitted by ingestion of the hyphal bodies and spores with the food.

Walter (E. V.) & LaHue (D. W.). **Notes on Food for Corn Ear Worm Adults.**—*J. econ. Ent.* **32** no. 1 p. 156. Menasha, Wis., 1939.

In the course of investigations necessitating the rearing of larvae of *Heliothis armigera*, Hb. (*obsoleta*, F.) during the winter, it was found that all the eggs laid by adults fed on a 10 per cent. solution of unfermented honey were infertile, whereas when freshly fermented dilute honey was used, about 93 per cent. of the eggs were viable. There appeared to be no difference in the food value of honey fermented with baker's yeast or that in which fermentation had been caused by wild yeasts present in the air. However, the addition of baker's yeast gives quicker fermentation with less danger of invasion by undesirable fungous growths.

Knowlton (G. F.) & Harmston (F. C.). **Elm Leaf Beetle in Utah.**—*J. econ. Ent.* **32** no. 1 p. 156. Menasha, Wis., 1939.

During the summer of 1938, *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) was found to be present at Smithfield (northern Utah). The

foliage of 6 large elm trees was skeletonised. Injury to 10 neighbouring trees was greatly reduced by thorough treatment with calcium arsenate dust. The beetle was probably introduced into Utah in 1936 or even 1935. No evidence of its presence was found in other parts of the State.

GARMAN (P.). **Control of the Rosy Apple Aphid in Connecticut Apple Orchards.**—*Circ. Conn. agric. Exp. Sta.* no. 126, 16 pp., 12 figs. New Haven, Conn., 1938.

In Connecticut, the eggs of *Anuraphis roseus*, Baker, which overwinter on the twigs and branches of apple, hatch in the second half of April, when the apple trees are in bud, and the stem-mothers become mature when the blossoms of most varieties are out, moving at this stage to the unfolding leaves. The numbers of Aphids often decline between bud and leaf infestations, but mount rapidly when the first stem-mothers reproduce. Towards the end of June, especially after warm weather, winged Aphids develop and migrate to *Plantago lanceolata*, the apple trees becoming free from infestation by the first week in July. In late September the Aphids return to the apple trees, and produce one generation before the winter eggs are laid in October, after the first frost, and November. Spring temperatures of 60–68°F. with at least 0·5 in. rainfall every 10 days are favourable for the Aphids, whereas dry weather or temperatures of 10°F. or less in October and November, and hot weather in May or June, whether it is dry, hastening migration from the apple trees, or wet, encouraging the development of disease, reduce infestation.

Natural enemies of *A. roseus* in Connecticut include the larvae and adults of the Coccinellids, *Adalia bipunctata*, L., *Ceratomegilla fuscilabris*, Muls., and *Anatis quindecimpunctata*, DeG., the larvae of *Syrphus torvus*, O.S., and several species of parasitic Hymenoptera besides diseases, about which little is known. An attempt to introduce *Hippodamia convergens*, Guér., into an orchard in Connecticut in 1935 was unsuccessful. The prediction of outbreaks, from the degree of infestation and number of parasites and predators in the previous year and the number of Aphid eggs on the twigs in winter, is discussed, and the characters distinguishing *A. roseus* and *Aphis pomi*, DeG. (the eggs of which cannot be distinguished) are described. It is not essential to control infestations unless more than 15 per cent. of the apples are deformed, as this proportion is usually removed when the fruit is thinned after the Aphids have left the trees.

Sprays of nicotine sulphate are less effective against *A. roseus* than against most Aphids, and it is advisable to use them at full strength with a spreader to wet the insect and to apply them very carefully before the leaves are curled, although they have also been used to prevent infestation of the fruit when the leaves are fairly well out and the Aphids begin to move about the tree. Nicotine in the form of a free alkaloid water solution is about as effective as nicotine sulphate. Dusts impregnated with nicotine have usually given poor results, but have sometimes afforded successful control when the air was still enough for the dust to hang in the trees and settle gradually and the temperature high enough to make the nicotine effective, preferably above 70°F. during the day. Tar-oil emulsion with only 2 per cent. oil kills the eggs at the dormant period, though light neutral tar oils are reported to be ineffective. The emulsion must be applied thoroughly

from all angles, and the operators and horses should be protected. Applied about 1st April, it reduced the numbers of deformed apples at harvest time considerably. Thorough sprays of nicotine sulphate (1 : 800) with lubricating oils, for delayed dormant use when the buds are beginning to show green and the Aphids are hatching, and nicotine sulphate with lime-sulphur have been recommended [*cf. R.A.E.*, A **24** 473]. In experiments carried out since 1936, lubricating-oil emulsions with 4 per cent. dinitro-o-cyclohexylphenol dissolved in the oil and applied about 1st April were found to be as effective as tar oil in killing Aphid eggs. They also kill the eggs of the European red mite [*Paratetranychus pilosus*, C. & F.]. With any of these sprays it is necessary to kill at least 90–95 per cent. of the Aphids or eggs for satisfactory control.

Suggested spray programmes based on this discussion are given, with some indication of the relative costs of the different materials.

Garman (P.) & Townsend (J. F.). **The European Red Mite and its Control.**—*Bull. Conn. agric. Exp. Sta.* no. 418, 34 pp., 6 figs., 29 refs. New Haven, Conn., 1938. [Recd. 1939.]

This account of measures against the European red mite [*Paratetranychus pilosus*, C. & F.] in Connecticut is introduced by a brief survey of its bionomics [*cf. R.A.E.*, A **23** 659, etc.] and the factors that affect its abundance. A list of Arthropods predacious on it is included, showing which of them occur in Connecticut, with notes on some of the latter. In this State, where it first attracted attention in 1920 [*cf.* **9** 293; **12** 220], it is of importance as a pest of apple, though it also occurs occasionally on cherry, peach, plum, elm and roses. Outbreaks are sporadic, and it is believed that they are caused by dry periods in mid-summer, trees crowded or in bad condition, poor soil, the absence of natural enemies, the growing of susceptible varieties of apple and the nature of the spray applied. The chief natural enemies, in order of apparent importance, are predacious mites (one or more species, referred for convenience to the genus *Seius*, *sens. lat.*) and Coccinellids (*Stethorus* spp.), thrips and the Anthocorid, *Orius insidiosus*, Say. Infestations may be expected in trees adjacent to those infested in the previous year, and they should be inspected for eggs at pruning time. A population of 3–6 eggs per 15-in. twig resulted in an outbreak in 1938.

The methods of control that have been used since 1923 are discussed, and data on the use of oil sprays at the dormant period are summarised [*cf.* **18** 545]. One of the problems is the combined control of *Paratetranychus* and Aphids, since tar distillates do not kill the former, and lubricating oils alone are not highly effective against the latter. In 1938, a 2 per cent. emulsion of lubricating oil containing 4 per cent. dinitro-cyclohexylphenol was effective against both [*cf.* preceding abstract], and had little effect on predacious thrips, but was injurious to *Seius*. A lime-sulphur spray, particularly with a spreader, is useful early in the season, but gives poor results in mid-summer. Wettable sulphur and sulphur dusts do not affect the mites at temperatures of less than 80–90°F. The sulphur may kill some of the predators, particularly *Seius* [*cf.* **26** 15]. Nicotine sulphate killed 36 per cent. of *P. pilosus* and may safely be used against Aphids or leafhoppers, since it does little harm to the predators. Derris or cubé sprays, which kill the young nymphs, but not the eggs, have in some cases

been combined successfully with the regular sprays, though they also kill many of the natural enemies. Thiocyanates at safe dilutions were unsuccessful against this mite, and little is known of their action on the predators. Summer oils, formulae for which are given, appeared to be successful [*cf.* **26** 16] except when applied at low temperatures (less than 60°F.). If used with lead arsenate or too soon after it, they may increase the arsenic residue at harvest, and they should not be used on plums or some varieties of apples within two weeks of harvest, or they will remove the bloom. They kill Coccinellids, but cause little reduction of predacious mites or thrips. Experience for several years has shown that outbreaks are prevented by natural enemies if the only summer treatment applied is a spray containing 10 lb. lime, 3 lb. lead arsenate and 1 U.S. quart light pressed menhaden fish oil or linseed oil, but this spray should not be used in very hot damp weather, when disease control is needed, or where varieties of apples susceptible to scab are interplanted with others. It should be applied without the fish oil in July.

P. pilosus sometimes becomes abundant on peaches, usually on those interplanted with infested apples. Control should be applied on the apple trees, but not on the peaches unless it is absolutely necessary, when they may be sprayed with stabilised oil to which 3 per cent. lime-sulphur is added against leaf curl. If necessary, plums may be sprayed with 3 per cent. oil.

BARBER (G. W.). **Hibernation of the Corn Ear Worm in southern Connecticut.**—*Bull. Conn. agric. Exp. Sta.* no. 419, 27 pp. New Haven, Conn., 1939.

The following is based on the author's introduction and summary: A change has occurred in the status of *Heliothis armigera*, Hb. (*obsoleta*, F.) in southern Connecticut, where it caused serious damage to maize for several consecutive years prior to 1935, whereas previously it had done so occasionally, but not annually. This yearly occurrence has been attributed to an annual migration of moths, the importation of the insect in consignments of green vegetables from the southern States [*cf. R.A.E.*, A **26** 271, 564], or the hibernation of pupae, and investigations were therefore carried out during 1935–38 in Connecticut and Massachusetts to determine whether the pupae can overwinter successfully, previous experiments in southern Connecticut having given negative results. During these three years, infestation began in June or July, in the earliest maize, with a few individuals which caused very little damage, but by August and September the numbers were much greater and resulted in considerable injury to growing maize. It is thought that these large populations can be traced to natural increase from the first individuals, when considered in connection with the maize acreage attractive to the ovipositing moths during the season. Most pupae were found at depths of 2–4 inches in the soil, but they occurred deeper in sandy than in other soils. Progressive destruction of the emergence burrows, which are made by the larvae to enable the moths to escape from the soil, occurred in outdoor cages from the time the larvae entered the soil during September until the following summer. Destruction of these burrows was due to several factors, of which freezing and thawing of the soil, the activity of earthworms and growth of roots of plants were the most important.

Pupae survived the winter in washed sand in a locality in Connecticut with a climate similar to New Haven during one year and in sandy soil in Massachusetts, where the climate was rather milder, during two years. They also survived in the soil of an open shed in a colder district in Connecticut during one year. Where they were protected from rainfall and extreme ranges of temperature, they survived in large numbers. The higher rate of survival in sand may be due to the better drainage and the greater protection from cold corresponding with deeper burial. It is concluded that the insect survived the winter in certain environments in southern New England, at least during some years. The number of survivors seemed adequate to account for the annual infestations that have occurred.

MICHELBACHER (A. E.) & ESSIG (E. O.). **Caterpillars attacking Tomatoes.**—*Bull. Calif. agric. Exp. Sta.* no. 625, 42 pp., 21 figs., 33 refs. Berkeley, Calif., 1938.

This bulletin contains accounts, previously given in a circular [*R.A.E.*, A **24** 661], of the bionomics and control of the chief Lepidopterous pests of tomato in California, and also the results of further investigations on some of them, particularly *Heliothis armigera*, Hb. (*obsoleta*, F.), made in 1936 and 1937.

Experiments with dusts against *H. armigera* were carried out in five different parts of the State, all dust mixtures being applied at the rate of 30 lb. per acre unless otherwise stated. Good control was obtained with undiluted commercial calcium arsenate (15 lb. per acre), 50 per cent. lead arsenate in talc (20 lb. per acre), and 40 per cent. synthetic cryolite or barium fluosilicate, each in soapstone. Three applications at intervals of 3–4 weeks, the first when 2–4 per cent. of the developing tomatos $1\frac{1}{2}$–$2\frac{1}{2}$ ins. in diameter are affected, should give seasonal control. Dusts of 40 per cent. sodium fluosilicate in aluminium silicate, 15 per cent. phenothiazine [thiodiphenylamine] in talc, and 24 per cent. Kutane (84 per cent. cuprous cyanide with a wetting and spreading agent, chiefly sulphite lye) in talc were much less effective, while mixtures of pyrethrum or derris with sulphur and one containing powdered Epsom salts (magnesium sulphate) gave no control. Periodical plantings of beans close to the tomatos during the entire harvest season of 1937 noticeably reduced the infestation of the latter; beans and maize are both infested in preference to tomatos if they are making a rapid and succulent growth. All tomato plants should be destroyed as soon as the harvest is over. Brief notes are given on three Noctuids that are often confused with *H. armigera*, *viz.*, *Plusia* (*Autographa*) *californica*, Speyer, and *Laphygma exigua*, Hb., which sometimes feed on the leaves of tomatos, and *H. phloxiphaga*, Grote & Rob. [*cf.* **26** 117], and on *Hyposoter exiguae*, Vier., which is one of its most common parasites. Infestations of tomato before August are unlikely, as more attractive crops are available earlier in the season.

In 1937, dusts of lead and calcium arsenate, cryolite and sodium and barium fluosilicate in the same proportions and quantities were tested against *Protoparce sexta*, Joh., and *P. quinquemaculata*, Haw. The arsenicals gave the best control, calcium arsenate being almost as effective as lead arsenate and preferable because of the residue problem. It was necessary to dust in the middle of July and again a month

later. No satisfactory chemical control of *Phthorimaea* (*Gnorimoschema*) *lycopersicella*, Busck, has been discovered, and in areas where serious infestations are likely, it may be necessary to grow only one crop of tomatos annually to avoid serious damage.

Since dusting during the harvest period is necessary to control *H. armigera* and *Protoparce*, the arsenic, lead and fluorine residues left on the tomatos were measured. It was found that the usual washing of tomatos to be canned reduced the residue to well below the legal tolerance, unless the trimmings were to be concentrated, when dipping the fruit into a bath of 1 per cent. hydrochloric acid was advisable. Other tomatos should be washed or carefully wiped.

Borden (A. D.). **Oil Sprays for Deciduous Fruit Trees by the Tank-mixture Method.**—*Circ. Calif. agric. Exp. Sta.* no. 345, 15 pp., 4 figs., 1 ref. Berkeley, Calif., 1938.

This circular is a revision of a bulletin on the tank-mixture method for dormant oil spraying of deciduous trees in California [*R.A.E.*, A **23** 102], with the addition of some notes on summer spraying [*cf.* **24** 540]. Further recommended formulae for tank-mixed dormant sprays are: 4 per cent. oil and 3 per cent. lime-sulphur against mealybugs on apple and pear; 5 per cent. oil against the Italian pear scale [*Epidiaspis leperii*, Sign.]; and 4 per cent. oil and 5 per cent. lime-sulphur against the oyster-shell scale [*Lepidosaphes ulmi*, L.]. The sprays recommended for summer use include 1·5 per cent. oil and 0·125 per cent. nicotine sulphate against immature mealybugs, and 1·5 per cent. oil against *Tetranychus telarius*, L., *Paratetranychus pilosus*, C. & F., and *Bryobia praetiosa*, Koch, on foliage or fruit. The addition of 1 gal. oil and $\frac{3}{4}$ pint nicotine sulphate [per 100 gals.] to lead arsenate sprays used against *Cydia pomonella*, L., will control Jassids on apple or pear, and the eggs of *C. pomonella* are destroyed by the addition of $\frac{3}{4}$ gal. oil if the spray is applied not more than 10 days after a heavy flight of the moths.

Field tests were carried out in 1935 with stationary spray equipment [*cf.* **25** 469, etc.] using a spray made by the tank-mixture method. Samples of spray taken at the end of 1,870 ft. lengths of pipe, even with an interrupted flow, showed uniform percentages of oil when the rate of flow was more than 2 ft. per second. Thorough agitation in the mixing tank is essential.

Boyce (A. M.). **Citrus Thrips Problem with particular Reference to Southern California.**—*Calif. Citrogr.* **23** pp. 288, 316–317, 4 refs. Los Angeles, 1938.

Scirtothrips citri, Moult., which has caused injury to orange in southern California for many years, has lately become of considerable importance on lemons, particularly in the interior and the adjacent foothills. In certain areas nearer the coast, it is now more injurious to lemons than to oranges. The eggs overwinter in the tissues of the young leaves, green twigs and fruits, and hatch in the second half of March. If the winter is warm, however, thrips may also be present on the trees. The larvae feed on the youngest tissues of the plant and complete the two larval instars in 3–21 days. The pre-pupal and pupal instars are passed among dried leaves, etc. on the soil beneath the trees and together last 2–34 days. The average for each of these two

periods is 8 days, and the life-cycle may be completed in 15 days in summer. There may be 6–8 generations, with considerable overlapping, during a year. Characters distinguishing this species from the flower thrips, *Frankliniella moultoni*, Hood, which also occurs on *Citrus* are described [*R.A.E.*, A **22** 157].

Control measures on orange are designed to protect the fruit until it reaches the size of a walnut, when it is resistant to serious injury. In central California, most of the orange trees receive three applications of sulphur dust [**18** 202], a programme comprising a spray of lime-sulphur and wettable sulphur at petal fall, or a winter spray of lime-sulphur or lime-sulphur and oil which is also effective against the citricola scale [*Coccus pseudomagnoliarum*, Kuw.]. In the interior and adjoining intermediate areas in southern California, where infestations of economic importance occur only sporadically on orange, recommendations for annual precautionary measures include a thorough application of sulphur dust at petal fall followed by a second 2–3 weeks later, though in certain seasons an earlier application may be necessary if the larvae are abundant ; or one application of a spray of lime-sulphur and wettable sulphur at petal fall. Both treatments, especially the spray, are effective against the red spider [*Paratetranychus citri*, McG.], and the dust is of some value in the control of the black scale [*Saissetia oleae*, Bern.].

Control on lemons presents different problems as young growth and small fruit normally occur in sufficient numbers to present conditions favourable to the continuous development of the thrips from spring till autumn. Damage consists in the scarring and deforming of the young twigs, leaves and fruit and injury to primary buds and to the adventitious buds that develop in their place. In the absence of young shoots, the flower-stalks may be attacked and the flowers fall. The multiple bud condition arising from the development of adventitious buds may prevent future bud development at that node or may result in the production of a number of weak twigs in rosette formation. In a common type of injury known as " rat-tailing " the twigs become bare of foliage.

A satisfactory control programme to maintain the thrips population at the lowest possible level throughout spring, summer and autumn without risk of injury to the fruit has not yet been developed, but one including applications of sulphur dust when the eggs hatch and about 3 weeks later is suggested. The second application should probably be made before May, when periods of high temperature, which would result in serious injury to the fruit by the sulphur, may occur. A single spring treatment with a spray of lime-sulphur and wettable sulphur is suggested for groves adjoining others in which sulphur drift would complicate an oil-spray programme, and for districts where the temperature is generally too low for the dusts to be fully effective ; this treatment appears to be fairly satisfactory in protecting the spring growth and set of lemons. Two further applications of sulphur dust at a lower rate are necessary, though accompanied by some risk, to protect the growth and autumn set of lemons during August and September, when the thrips have again become numerous ; treatments made during May–July appear to be more liable to scorch the fruit than later ones, when the fruit has been exposed to high temperatures for extended periods.

Investigations in progress indicate that sulphur dusts to which certain zinc compounds and other materials have been added are less

injurious than sulphur alone [*cf.* **25** 409, 624] ; that the addition to sulphur, which destroys the young larvae, of substances that are toxic to later stages would also probably be of value ; and that treatment of soil against the pupae and the use of stomach poisons against the active stages on the trees are beneficial.

GAHAN (A. B.). **Notes on some Genera and Species of Chalcidoidea (Hymenoptera).**—*Proc. ent. Soc. Wash.* **40** no. 8 pp. 209–227. Washington, D.C., 1938.

These notes involve some generic and specific synonymy, several generic transfers, and some new distributional records for several species of economic importance. New synonymy of species that have been mentioned in this Review includes *Eurytoma monemae*, Ruschka (*parasae*, Gah.) ; *E. nesiotes*, Crwf. (*denticoxa*, Gah.) ; *Dibrachys cavus*, Wlk. (*clisiocampae*, Fitch, *Pteromalus gelechiae*, Webster, *Arthrolytus apatelae*, Ashm.) ; *Tritneptis klugi*, Ratz. (*Coelopisthia* (*Pteromalus*) *nematicida*, Pack.) ; *Heteroschema rugosopunctata*, Ashm. (*prima*, Gah.) ; and *Melittobia* [*Syntomosphyrum*] *indicum*, Silvestri (*Acerato-neuromyia australia*, Gir., this species being the type of its genus). *Ipocoelius* is considered congeneric with *Tomicobia*. *Pteromalus klugi*, Ratz., and *Coelopisthia scutellata*, Mues., are transferred to *Tritneptis* and *Dibrachys australia*, Gir., to *Pseudomicromelus*. Keys are given to the North-American species of *Tritneptis* and *Cheiropachus*, and the status of the former, of which the type is *T. hemerocampae*, Gir., is discussed. *Tritneptis diprionis*, sp. n., is described from *Diprion* (*Neodiprion*) *sertifer*, Geoffr., and unidentified sawflies on conifers in the New England States and Minnesota, and *T. koebelei*, sp. n., from cocoons, probably of *Caliroa limacina*, Retz. (*cerasi*, auct.), on pear in California.

Annual Report of the Agricultural Experiment Station (University of Puerto Rico) for the Fiscal Year 1936–1937.—167 pp. S. Juan, P. R., 1938.

In the Report of the specialist for minor crops (pp. 56–63) by E. M. Sales, it is stated that at harvest (March 1936) infestation of sweet potato in Porto Rico by *Cylas formicarius*, F., was only 5·74 per cent. in a field that had been planted with tender vines (end shoots), whereas it was very much higher in fields in which mature stems were used. The high rates of infestation in two other fields in which end shoots were planted are attributed to cracking of the silty clay soil in dry weather and lack of rain during the growing period [*cf. R.A.E.*, A **26** 223].

In the Report of the Division of Entomology (pp. 82–102), G. N. Wolcott gives an account of further releases of *Rodolia cardinalis*, Muls., against *Icerya purchasi*, Mask., on *Casuarina*. Infestation by the scale was spread by movement of stock and by wind. *Casuarina* in one locality was infested by a species of *Palaeococcus* (*Crypticerya*), probably *rosae*, Ril. & Horw., but a week after the Coccinellid was released on the trees (May 1937) this Coccid had almost disappeared.

Experiments in progress on the resistance of woods from various regions to attack by *Calotermes* (*Cryptotermes*) *brevis*, Wlk. [*cf.* **13** 196] indicated that none is definitely immune. Coarse-grained woods were more attacked than others, but hardness afforded no protection.

Descriptions are given of the larvae of *Maruca testulalis*, Geyer, *Fundella cistipennis*, Dyar, and *Etiella zinckenella*, Treit., the three Pyralids that attack lima beans in Porto Rico [*cf.* **22** 153], and earlier work on the control of the last two, by means of pyrethrum sprays [**23** 114] is recapitulated. In experiments begun in February 1936, the Pyralid infesting lima-bean pods was *F. cistipennis*, but by the end of March only *Etiella* was present. The numbers of larvae in ten weekly collections of 100 pods from plants sprayed twice weekly with pyrethrum and from those dusted with preparations of cubé were 138 and 53, respectively, as compared with 94 in pods from untreated plants. Similar results were given by further work in the winter of 1936–37 against *F. cistipennis*. Although in a preliminary test against *Aulacaspis pentagona*, Targ., and *Pseudoparlatoria ostreata*, Ckll., on papaya complete mortality of the former was obtained without injury to the tree by spraying and painting it with a 10 per cent. emulsion of Sunoco oil, subsequent tests in which infested trees were painted with various dilutions showed that injury, possibly due to wet weather, was excessive and mortality uncertain.

In further work on the biological control of *Leucoptera coffeella*, Guér., on coffee, investigations in St. Lucia in the summer of 1936 were inconclusive, owing to the light infestation of coffee, but an undescribed Braconid of the genus *Mirax* was observed in July parasitising almost two-thirds of the larvae of the Tineid in Guadeloupe. Of 6 pupae of *Leucoptera* obtained there in November, when the leaf-miner was scarce, 5 were parasitised, and 3 females of the Braconid were successfully transported to Porto Rico and released in a small coffee grove. There was found to be a correlation between evaporation and leaf-miner population. Observations showed that to reduce the action of the wind, and consequent evaporation, effectively, hedges should be dense and high.

Since paper cups had proved unsatisfactory as containers for bait against the ant, *Myrmelachista ambigua ramulorum*, Wheeler [*cf.* **26** 223], small tubes, perforated in several places, and shelves of metal foil, were tested. Tubes 2 ins. wide were more effective than narrower ones when hung on the trees, but it appeared that access to the bait was too restricted. The bait containing codfish flakes was again the most attractive. When used together with tubes, the shelves were unsatisfactory, and the bait, which did not contain codfish, dried before it was consumed. It is considered, however, that shelves might be useful on trees not previously baited. Individuals of *Paratrechina* (*Prenolepis*) *longicornis*, Latr., were also killed by the bait, but the colony was unaffected as the dead were not taken back to the nest.

Work on the introduction into Porto Rico from Brazil of *Larra americana*, Sauss., for the control of *Scapteriscus vicinus*, Scud., is recapitulated [*cf.* **27** 85]. Some mortality of the Sphegid was caused by the spraying of the aeroplanes conveying them with pyrethrum just before they reached Porto Rico. Investigations in the autumn, made in view of proposed experiments on the value of liberating artificially reared individuals of *Trichogramma minutum*, Riley, to supplement the control of *Diatraea saccharalis*, F., on sugar-cane by those already present, indicated that, in autumn, high rainfall is favourable to the parasite. *Trichogramma* naturally controls the moth-borer during the time of high rainfall, and when rainfall is high during most of the year, natural control is commercially effective. In irrigated regions, where egg-clusters are scarce, few eggs are parasitised, and the damage to

the cane is much greater. The number of egg-clusters increases after heavy rainfall, and parasitism may reach 100 per cent. It appears to be unaffected by temperature. In 1937, the numbers of mature larvae of *Diatraea* per ton of ripe cane were 248 and 542 for the north coast, where the annual rainfall is high, and the south coast, where it is low, respectively.

In the Report of the agricultural experiment substation (Isabela) (pp. 149–167) by L. A. Serrano, it is stated that preliminary investigations in the winter of 1936–37 on the control of *Thrips tabaci*, Lind., on onion by means of flooding the plots were inconclusive, owing to destruction of the thrips by heavy rain in January. Flooding once a week gave some increase in crop, whereas in comparison, plants flooded twice weekly turned yellow earlier and were somewhat stunted.

WIGGLESWORTH (V. B.). **The Principles of Insect Physiology.**—Roy. 8vo, viii+434 pp., 316 figs. London, Methuen & Co., Ltd., 1939. Price 30*s*.

In this text-book, the main emphasis throughout is on the functions of the organs and tissues ; descriptions of anatomy are reduced to the minimum needed to explain the physiological argument. It is designed to set out the general principles of insect physiology and to illustrate each physiological characteristic by a few concrete examples, with bibliographic references to guide the student to the more important sources of information.

The author points out that, though it is not the purpose of physiology to furnish directly the means of insect control, the rational application of measures (whether these be insecticides or artificial interferences with the insect's environment) is often dependent on a knowledge of the physiology of the insect concerned. Physiology may thus serve to rationalise existing procedures, or to reveal the weak spots in the ecological armour of a species. A knowledge of the ecology of a species is always necessary for its effective control ; its ecology can be properly understood only when its physiology is known.

THOMPSON (W. R.). **Some beneficial Insects.**—*Bull. Minist. Agric.* no. 20 (4th edn.), 26 pp., 2 pls. London, H.M.S.O. 1939. Price 9*d*.

Since the appearance of the first edition of this publication [*R.A.E.*, A **10** 339], knowledge of beneficial insects has been greatly extended, and measures that can be taken to increase their usefulness have been widely studied in various parts of the world. In this fourth edition, the text has been entirely rewritten, though the plates from the earlier editions are retained. A general account is given of the mechanism of the natural control of insect pests and the ways and degree in which it is effected by their insect enemies, followed by brief surveys of the biology of Coccinellid, Carabid, Syrphid and Chrysopid predators and Hymenopterous and Dipterous parasites, and of the value of biological control.

Experience has shown that introduced parasites are not, as has sometimes been thought, of value only on islands with a limited fauna. Though the importation of parasites is not always successful

against an introduced pest, very satisfactory results have repeatedly been obtained in continental areas with a rich and varied fauna, including an abundance of hyperparasites. The general view now is that the method of biological control ought always to be tried in relation to introduced insects. In this connection, the work of the parasite laboratory of the Imperial Institute of Entomology is briefly outlined. In the course of 9 years, it has dispatched over 630 shipments of beneficial insects to various parts of the world ; and as a result, many species have been established and some outstanding successes have been obtained. Further, it seems possible that indigenous pests might be controlled by imported parasites and predators of allied insects. Investigations on practical methods of increasing the effectiveness of indigenous parasites are continuing, and have been successful with a parasite [*Encarsia formosa*, Gah.] of the greenhouse whitefly [*Trialeurodes vaporariorum*, Westw.], in Great Britain, and with *Cryptolaemus montrouzieri*, Muls., against mealybugs in California. It has also been shown that conditions in the field may be adjusted in favour of the natural enemies of pests, suitable forest management, for instance, maintaining the parasites and predators of *Myelophilus piniperda*, L., at a continuously high level and diminishing the number of outbreaks [*cf.* **25** 645]. When artificial control is used, the natural enemies of the pests should be considered, the sprays or dusts being applied in such a way that they are not injured.

Pape (H.). **Die Praxis der Bekämpfung von Krankheiten und Schädlingen der Zierpflanzen.** [The Practice of Control of Diseases and Pests of Ornamental Plants.]—Med. 8vo, 3rd revd. edn., viii+475 pp., 336 figs., 8 col. pls., 5 pp. refs. Berlin, Paul Parey, 1939. Price *Mk.*19 (less 25 per cent. outside Germany).

This book is divided into two sections. In the first, the author discusses the economic importance of pests and diseases of ornamental plants, including trees, and describes the principal measures for their prevention or control, including soil disinfestation and the use of sprays, dusts, fumigants and baits, directions for the preparation of which are given. In the main section (pp. 136–448), he gives more detailed information on the commoner fungous and virus diseases and animal pests, the majority of which are insects, that attack ornamental plants, together with the control measures appropriate for each, and an alphabetical list of plants showing the organisms by which they may be attacked.

Schmidt (G.). **Gebräuchliche Namen von Schadinsekten in verschiedenen Ländern.** [Popular Names of Insect Pests in various Countries.]—*Ent. Beih. Berl.* **6** 160 pp. Berlin, 1939.

The first section of this work comprises lists of over 1,700 invertebrate pests, almost exclusively insects, mites and ticks, arranged alphabetically under their German popular names and their specific names, followed by an index to the genera and a bibliography. The second section is the first part of a similar list of popular names in languages other than German, chiefly English, the last name given being " European furniture beetle." It is to be concluded in 1940.

Faes (H.). **Switzerland : Outbreak of** *Laspeyresia* (*Cydia*) *molesta* **and** *Ceresa bubalus* **in the Country.**—*Int. Rev. Agric.* **30** no. 2 p. 28M. Rome, 1939.

Records are given of the discovery in Switzerland of *Cydia* (*Laspeyresia*) *molesta*, Busck, on peach in the Ticino and near Lausanne in 1937 [*R.A.E.*, A **26** 163], and of *Ceresa bubalus*, F., in central Valais in September 1938 [*cf.* **27** 169], when it caused considerable damage to apple and pear trees. In 1938, *C. molesta* was rare in the Ticino and only a single larva was found at Lausanne.

Gieysztor (M.) & Pawłowicz (J.). **Beobachtungen über das Massenauftreten von** *Erannis*- **und** *Operophtera*-**Arten (Lep.) in einem Eichenwalde der Oberförsterei Rogów (Polen).** [Observations on the Mass Occurrence of Species of *Erannis* and *Operophtera* (Lep.) in an Oakforest in Rogów (Poland).] [*In German.*]—*Polsk. Pismo ent.* **16–17** pp. 16–36, 3 figs., 26 refs. Lwów, 1939.

An unusual outbreak of the Geometrids, *Erannis aurantiaria*, Hb., and *E. defoliaria*, Cl., occurred in 1935 and 1936 in the Province of Warsaw on oaks in a mixed forest consisting chiefly of oak trees 150–170 years old. Observations on the larvae on the trees, and counts of pupae in samples of forest litter and of the adults caught on adhesive bands showed that *E. aurantiaria* represented 52 per cent. and *E. defoliaria* 41 per cent. of all the Lepidoptera present on the oaks; the others included *Operophtera brumata*, L. Young trees and some of the old ones were completely defoliated, and the larvae also attacked hazel (*Corylus avellana*), *Sorbus aucuparia*, and especially *Vaccinium myrtillus*. In 1935, the larvae began to feed in late April, the first pupae were found in the litter in mid-June, and the adults emerged in October and laid eggs on or near the buds. The males were strongly attracted to light, but did not react to baits.

In 1936, an area of 75 acres of trees severely infested with *Erannis* and *O. brumata* was sprayed between 15th and 21st May with Paris green (2·8 lb. per 100 gals. water with the addition of milk of lime). The spray was applied with knapsack sprayers and was very effective, especially on the lower foliage, on which practically all the larvae were killed. The outbreak did not recur in 1937.

Large numbers of the larvae of *Erannis* were destroyed by predacious insects, including the Carabid, *Calosoma inquisitor*, L., which was the most important, and *Thanatophilus* (*Xylodrepa*) *quadripunctatus*, L., *Panorpa communis*, L., and *Chrysopa* sp., which were also numerous. The larvae were sometimes attacked by those of the Noctuid, *Monima cruda*, Schiff. (*pulverulenta*, Esp.), which fed on the oak leaves with them, and possibly by those of *Calymnia trapezina*, L. Parasites reared from the larvae of *E. defoliaria* were *Rhogas testaceus*, Spin., and *Lydella* (*Anetia*) *nigripes*, Fall., which was also obtained from a larva of *M. cruda*. *Ichneumon fabricator*, F., was reared from pupae of *E. defoliaria*, and *Winthemia quadripustulata*, F., and *Parabatus cristatus*, Thoms., from pupae of *M. cruda*. These are new host records for *R. testaceus*, *I. fabricator* and *W. quadripustulata*, and the first host record for *P. cristatus*.

[Chesnokov (P. G.).] **Чесноков (П. Г.). The Distribution and economic Importance of Pests of the Foliage of cruciferous Vegetable Crops.** [*In Russian.*]—Roy. 8vo, 90 pp., 53 refs. Leningrad, Izd. vsesoyuzn. Akad. s.-kh. Nauk Im. Lenina, 1936. Price 3 *rub.* [Recd. 1939.]

This is a compilation of data obtained during a few years prior to 1934 on the distribution, development and importance of insects that attack the foliage of cruciferous vegetables in various parts of the Russian Union. The pests concerned are *Phyllotreta* spp., *Entomoscelis adonidis*, Pall., *Colaphellus hoefti*, Fald., *Phaedon cochleariae*, F., *Barathra brassicae*, L., *Plutella maculipennis*, Curt., *Pieris* spp., *Athalia rosae*, L. (*colibri*, Christ), *Brevicoryne brassicae*, L., and *Eurydema* spp. Special attention is devoted to the phenology of the more important species, and the determination of the periods in which the injurious stages are most numerous on the crops. A provisional estimate is made of the economic importance of certain species in different regions.

Свекловодство. [Beet Cultivation.] **Tome III. Part I. Pests of Sugar-beet and their Control. Part II. Diseases of Sugar-beet and their Control.** [*In Russian.*]—Super roy. 8vo, 392 pp., illus., many refs. [Kharkov] Gos. Izd. kolkh. sovkh. Lit. USSR. [1938]. Price 14 *rub.*

This text-book, to which a number of authors have contributed, is intended to provide growers of sugar-beet in the Russian Union with an outline of the present status of the control of pests and diseases of this crop. The first part (pp. 11–200, 144 figs., 6 pp. refs.) opens with estimates of the losses caused to beet crops in the Russian Union by various pests, and a discussion of the causes responsible for outbreaks and the possibility of forecasting them. Further chapters deal with the mechanical, chemical and biological methods of protecting beet from pests, the bionomics and control of a large number of insect pests of sugar-beet occurring in the Russian Union and of pests other than insects, and the organisation of a system of control measures at different periods of growth of the beet. A key is given for the identification of the pests by the kinds of injury they cause, and a subject index is appended, as well as indices to the insects, other animals and plants under their Russian and scientific names. A bibliography of Russian literature is divided into 12 sections dealing with different groups of pests and the technique and organisation of control.

The second part (pp. 203–392, 79 figs., 222 refs.) contains a chapter (pp. 263–270) on virus diseases of beet in the Russian Union and elsewhere, in which mention is made of their insect vectors.

[Rodendorf (B. B.).] **Родендорф (Б. Б.). Key to the Larvae of Fruit Flies.** [*In Russian.*]—La. Cr. 8vo, 30 pp., 41 figs., 17 refs. Moscow, Izd. tzentr. karant. Lab., 1938.

This booklet contains a key to the Dipterous larvae most often found in fruits at quarantine stations in the Russian Union. They comprise the Trypetids, *Ceratitis capitata*, Wied., in oranges, apricots and peaches, *Dacus oleae*, Gmel., in olives, *Rhagoletis pomonella*, Walsh, in apple, *R. cerasi*, L., in cherries, *Myiopardalis* (*Carpomyia*) *pardalina*, Big., in cucurbits and *C. schineri*, Lw., *C. vesuviana*, Costa, and *C. incompleta*,

Becker, in the fruits of *Zizyphus* spp., the Lonchaeid, *Lonchaea aristella*, Beck., which infests figs, and some other Diptera liable to be confused with them. Notes on the distribution, bionomics and importance of the injurious species, a general description of the morphology of a Trypetid larva, and instructions for the preparation of specimens are also included.

[Shevchenko (M. I.).] **Шевченко (М. И.). Entomological Analysis of Seeds and Fruits by the Method of Radiography.** [*In Russian.*]—La. Cr. 8vo, 20 pp., 4 figs. Moscow, Izd. tzentr. karant. Lab., 1939. (With a Summary in English.)

Much of the information contained in this paper has already been noticed [*cf. R.A.E.*, A **27** 147]. In addition, the action of the X-rays when applied to infested seeds or fruits is explained, and the apparatus employed by the author for the detection of pests in them is described. Soft rays were used, as they give the most accurate radiographs. More information is also given on the technique of the method, and additional examples are cited of its successful use to detect larvae of different pests in seeds of various crops. It is emphasised that the analysis of seeds is carried out from 4 to 10 times as quickly as by the usual method of opening them.

Noguchi (T.) & Hiraiwa (Y.). **Studies on Fumigation with Cyanic Gas.** [*In Japanese.*]—*Shizuoka agric. Exp. Sta., Extra Rep.* no. 46, 50 pp. Shizuoka, Japan, 1938.

The use of hydrocyanic acid gas against pests of *Citrus* is increasing in Japan. Studies showed that the gas is better generated from sodium cyanide when the grains are small, and that diluted sulphuric acid generates it more rapidly at high temperatures. Sodium cyanide dissolved in water produces more gas in the first 5 minutes than it does when used in solid form.

Oishi (T.). *Macropsis munda* **Uhler injures Grape.** [*In Japanese.*]—*J. Plant Prot.* **25** no. 12 pp. 913–914, 1 pl. Tokyo, 1938.

The Jassid, *Bythoscopus* (*Macropsis*) *munda*, Uhler, which usually feeds on willow, is recorded from grape vines in Japan.

Ishibashi (R.). **Control of Insect and Fungous Pests of Substitute Materials.** [*In Japanese.*]—*J. Plant Prot.* **26** no. 1 pp. 36–39. Tokyo, 1939.

Larvae and adults of *Tenebroides mauritanicus*, L., were observed boring in staple fibre (a string made of wood fibre) in grain storehouses in Japan. This string was also damaged by a Gryllid.

Kuwayama (S.). **On the Effectiveness of Lime Arsenate for the Control of** *Lema oryzae* **Kuway.** [*In Japanese.*]—*J. Plant Prot.* **26** no. 5 pp. 323–329. Tokyo, 1939.

A brief account is given of the bionomics of *Lema oryzae*, Kuway., on rice in Japan. Plants that are injured by this Criocerid in early summer may recover later in the season, but maturation is retarded.

The injury is especially serious in northern Japan, because the summer is shorter. Calcium arsenate is more effective as a spray than lead arsenate or potassium fluosilicate, and in Hokkaido it should be applied two or three times, during the periods of oviposition and hatching.

YAGO (M.). **Interesting injurious Insects in Shizuoka Prefecture in 1938.** [*In Japanese.*]—*J. Plant Prot.* **26** no. 5 pp. 337–341. Tokyo, 1939.

Notes are given on insect pests in Shizuoka Prefecture in 1938. Eggs of the Pentatomid, *Megymenum gracilicorne*, Dall. [see next abstract], are parasitised by *Telenomus mitsukurii*, Ashm. *Hymenia recurvalis*, F., was observed on spinach, *Aristotelia* sp. infested *Iris*, and *Patanga succincta*, L., attacked the leaves of *Citrus*. An outbreak of *Cirphis unipuncta*, Haw., occurred in one district immediately after a flood, but the larvae were destroyed by a second flood in July.

YAGO (M.). **Notes on *Megymenum gracilicorne* Dallas.** [*In Japanese.*] —*Trans. Kansai ent. Soc.* no. 8 pp. 6–7, 1 fig. Osaka, 1939.

The Pentatomid, *Megymenum gracilicorne*, Dall., which is widely distributed in Japan, recently appeared in numbers at Numazu, Shizuoka Prefecture, where it caused considerable injury to pumpkins, and also attacked potatoes, grape vines and cucumbers. The overwintered adults begin to feed in late April, and females oviposit from mid-May to the autumn. The eggs hatch in 12–15 days, and the nymphs become adult by September or October. All stages are briefly described.

KABURAGI (T.). **On the physical Characters of the Light Sources of Light Traps for *Chilo simplex* Butl.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **10** no. 6 pp. 204–207. Tokyo, 1938.

In this summary of work in Japan on the use of light-traps against *Chilo simplex*, Btlr., on rice, it is stated that about 1,200,000 electric and petroleum-oil light-traps are at present in use. The ultra-violet rays (wavelength 330–400 μμ) are the most effective for attracting the adults of both sexes. The decrease in efficiency is rapid as the length of the light waves increases to violet and is then more gradual. Light of which the wave-lengths exceed 640μμ is only slightly attractive. The limit of economic efficiency appears to be 500μμ.

KOJIMA (T.). **Effect of high Temperatures upon the Hatching of the Eggs of *Dendrolimus spectabilis* Butl.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **10** no. 6 pp. 213–226. Tokyo, 1938.

In further studies on the eggs of *Dendrolimus spectabilis*, Btlr., a pest of pines in Japan [*cf. R.A.E.*, A **23** 677 ; **25** 224], eggs of the first batches deposited by females were kept at 25°C. [77°F.] and 90 per cent. humidity, and exposed to 36 or 38°C. [96·8 or 100·4°F.] at various humidities for 1 or 2 days at various ages. At 25°C., the egg stage usually lasts over 8 days. In the case of eggs kept at 36°C. for 1 day, exposure at 100, 90 and 50 per cent. humidity caused very little mortality, but exposure at 18 per cent. killed 40 and 61 per cent. of

those 4 and more than 4 days old, though those 1 or 2 days old were not affected. Exposure to 38°C. for 1 day at over 50 per cent. humidity had a greater effect on eggs 2 days old than on older ones. When the humidity was decreased to 18 per cent., more eggs died at 38°C. than at 36°C. The percentage mortality was greater after 2 days at 36°C. than after 1, and increased with the age of the eggs, except that it slightly decreased for those a week old. Exposure to 38°C. for 2 days killed all eggs 1–5 days old, but only 27·2 and 80·9 per cent. of those a week old when the humidities were 100 and 90 per cent., respectively. Exposure to high temperature increased the length of the egg stage; the increase resulting from exposure for 1 day was greatest in eggs 2 days old, followed by those 8–9 days old, and least in those newly deposited.

Aino (S.). **Reactions of** *Cremastus biguttulus* **Munakata to coloured Lights. (Preliminary Report.)** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **10** no. 6 pp. 227–233, 1 fig. Tokyo, 1939.

The Ichneumonid, *Cremastus flavoorbitalis*, Cam. (*biguttulus*, Munakata), a parasite of *Chilo simplex*, Btlr., in Japan, is diurnal in habit, but is sometimes attracted to strong lights at night. In experiments in which Wratten light filters were used to compare coloured and uncoloured lights, attractiveness was greatest at wave-lengths of 330–400μμ, and decreased with an increase in wave-length.

Fukaya (S.). **Effect of Temperature and Humidity upon the Development of** *Apanteles liparidis* **Bouché and its Parasites.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **10** no. 6 pp. 234–244. Tokyo, 1938.

Investigations on *Apanteles liparidis*, Bch., a parasite of the larvae of *Lymantria dispar*, L., that is widely distributed in Japan [*cf. R.A.E.*, A **27** 209], showed that the egg and larval stages, which are passed within the host, together last 14 days at 20°C. [68°F.]. Humidity had little effect on pupal development, which was more rapid at temperatures between 13 [55·4°F.] and 20°C. than at higher or lower ones. Adults emerged at temperatures below 32°C. [89·6°F.] at humidities of over 70 per cent., but not below 13 or above 30°C. [86°F.] when the humidity was below 60 per cent. Larvae in cocoons kept for 1 day at 35·5°C. [95·9°F.] and then at 25°C. [77°F.] and 92 per cent. humidity were unable to pupate and died, and pupae treated in a similar way 1 day before emergence were also killed, but pupae 1, 3 and 4 days old were not injured.

Yagi (N.). **Detection of Dipterous Parasite of the Silkworm Pupa by the Action Current.** [*In Japanese.*]—*Kontyû* **12** no. 6 pp. 226–227, 2 figs. Tokyo, 1938.

A method is described of determining the presence and situation of larvae of the Tachinid, *Sturmia* (*Crossocosmia*) *sericariae*, Rond., in pupae of the silkworm [*Bombyx mori*, L.] by means of a galvanometer that records the electric current generated by their feeding movements.

Fukuda (S.). **Biology of *Mormoniella vitripennis* Walk., a Parasite of *Sturmia sericariae* Corn.** [*In Japanese.*]—*Zool. Mag.* **51** pp. 185–194, 3 figs. Tokyo, 1939.

Descriptions are given of all stages of *Mormoniella vitripennis*, Wlk., and of its bionomics in Japan, where it parasitises pupae of *Sturmia sericariae*, Rond., a Tachinid parasite of silkworms [*Bombyx mori*, L.]. Pairing occurred soon after emergence, and females deposited batches of 5–13 eggs on host pupae over 1 day old. The number of parasites reared from pupae, which may be attacked several times, ranged up to about 90, and females deposited up to 62 eggs daily. At 25–26°C. [77–78·8°F.], the egg, larval and pupal stages lasted 1–2½, 7–10 and 4½–7½ days, respectively. There are over 8 generations a year, the larvae hibernating from late October. This Pteromalid also attacks house-flies [*Musca domestica*, L.] and other Diptera, but as it does not enter the soil, it is not very effective against *Sturmia*, which usually pupates underground.

Kono (H.) & Sawamoto (T.). **The Relation of Insect Pests to two Varieties of *Ulmus* with different Bark Characters.** [*In Japanese.*] —*Bot. & Zool.* **7** no. 5 pp. 883–888, 2 figs. Tokyo, 1939.

Notes are given on the insects that occur in Hokkaido on *Ulmus propinqua* and a variety of this elm (var. *suberosa*), of which the bark is abnormally developed. Of the Coccids, *Lecanium kunoense*, Kuw., is commoner on var. *suberosa*, and *Phenacoccus pergandei*, Ckll., and *Lepidosaphes tubulorum*, Ferris, on the typical form, while *Lepidosaphes ulmi*, L., occurs on both indifferently, but is rare. The galls of *Gobaishia japonica*, Mats., *Byrsocrypta gallarum*, Gmel. (*Tetraneura ulmi*, DeG.), *B.* (*T.*) *fusiformis*, Mats., and *Eriosoma ulmi japonicum*, Mats., are common on *U. propinqua*, but rare on var. *suberosa*. These Aphids give rise to sexual forms on the bark after returning from their intermediate food-plants. *Chromaphis nirecola*, Shinji, and *Myzocallis* (*Sappocallis*) *ulmicola*, Mats., which feed on the leaves, are common on both varieties.

Kuroda (M.). **The Time of Emergence, Feeding and Oviposition of *Phytomyza nigricornis* Macq.** [*In Japanese.*]—*Bot. & Zool.* **7** no. 5 pp. 943–945, 2 figs. Tokyo, 1939.

Observations in Japan showed that the adults of *Phytomyza atricornis*, Mg. (*nigricornis*, auct.) [*cf.* next abstract], the larvae of which pupate in mines in the leaves of peas and crucifers, emerge between early morning and noon, but not later in the day. This is apparently due to variations in light intensity. The females fed on the juices that exuded from wounds made by the ovipositor in the leaves, and lived for a month on peas. Feeding and oviposition did not occur at night.

Ishitani (F.). **On the Scientific Name of the Leaf-mining Fly of Cruciferous Vegetables.** [*In Japanese.*]—*Kontyû* **13** no. 2 p. 82. Tokyo, 1939.

In Japan, the name *Phytomyza nigricornis*, Macq., has been used for the fly that mines the leaves of cruciferous and other vegetables [*cf. R.A.E.*, A **25** 713 ; **26** 605 ; **27** 207], but it is pointed out that this is

a synonym of *P. affinis*, Fall., which does not infest pea or *Astragalus sinicus*. The correct name for the leaf-miner of vegetables is *P. atricornis*, Mg., the food-plants of which include *Sonchus*, lettuce and *Astragalus*.

HIRAYAMA (S.). **Observations on the Transmission of the Tobacco Virus.** [*In Japanese.*]—*Rep. Jap. Ass. Adv. Sci.* **14** no. 1 pp. 150–153. Tokyo, 1939.

Heliothis (*Chloridea*) *assulta*, Gn., causes considerable injury to tobacco [*Nicotiana tabacum*] in Japan. When larvae of this Noctuid were transferred from tobacco plants infected with a virus disease to healthy ones and allowed to feed for a day, symptoms of the disease were subsequently observed in the latter. Larvae kept on diseased tobacco for 5 days and then starved for 2 days contained no excreta ; inoculation of their body-fluid produced the disease in *N. glutinosa*, but not in tobacco. When larvae from diseased tobacco were placed on healthy plants of *Physalis francheti*, they transmitted the virus for up to 2 days, and the virus was observed in an attenuated form in the excreta of larvae fed on the diseased plants.

YAMAZAKI (M.) & ARIKADO (H.). **Resistance of Sugar Cane Varieties to *Ceratovacuna lanigera* Zehnt. and the Concentration of the Cell Sap.** [*In Japanese.*]—*Rep. Jap. Ass. Adv. Sci.* **14** no. 1 pp. 153–155. Tokyo, 1939.

Observations in Formosa in the dry season of 1938 showed that in varieties of sugar-cane that were only slightly attacked by *Oregma* (*Ceratovacuna*) *lanigera*, Zehnt. [*cf. R.A.E.*, A **22** 521], the concentration of the cell sap in the leaves was low (averaging about 4·5° Brix), but in those that were heavily infested it was high (5·9° Brix). When a sugar-cane field was irrigated in a dry season, the concentration was reduced, and the Aphids on the leaves dropped to the ground on the following day. Healthy sugar-cane in fertile soil usually has a less concentrated cell sap and is generally less attacked by the Aphids, while non-resistant varieties are very little attacked in the rainy season, when the concentration is reduced (2–2·7° Brix). The Aphids are apparently unable to breed on leaves with cell sap of a concentration less than 4·5° Brix.

YASHIRO (H.). **Notes on *Anophia leucomelas*, L., a Pest of the Sweet Potato. 1.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 202–215, 4 figs. Tokyo, 1939.

Descriptions are given of all stages of the Noctuid, *Anophia leucomelas*, L., which is sometimes abundant on sweet potato in Kyushu and the Loochoo Islands [*cf. R.A.E.*, A **16** 226] and which caused serious damage in the latter in April and May 1934. The larvae fed on the young leaves and stalks, and sweet potato was the only plant attacked in the field, though adults were obtained in the laboratory from larvae fed on *Ipomoea aquatica* and *I. indica*. None was obtained, however, on *I. palmata*. There are probably 7 generations a year, the life-cycle requiring 25–29 days in summer, and 84 in winter. The egg stage averaged 4·3 and 16·6 days at 28 and 14·8°C. [82·4 and 58·64°F.], respectively, and the larval, prepupal and pupal stages lasted about 15, 4, and 11 days in summer and 33, 7, and 72 days

in winter. Pupation occurs in the soil, and the adults usually emerge in the evening. Females, which deposited an average of 526 eggs, lived about a week, and males about 5 or 6 days. The moths are attracted to light to some extent.

KURODA (S.). **Notes on** *Anophia leucomelas* **L., in Nagasaki Prefecture.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 216–221, 2 figs. Tokyo, 1939.

Anophia leucomelas, L., attacks sweet potato and also *Calystegia japonica* in Nagasaki Prefecture, where it is most injurious in September and October, and caused serious damage in 1937. The adults begin to emerge in May, and the larvae appear about the middle of the month. The eggs are laid singly at night, mostly on the upper surfaces of the leaves. The largest number of eggs laid by one moth was 573. The egg, larval, prepupal and pupal stages lasted 5–8, 14–30, 6–11 and 9–10 days, respectively. Many larvae were killed by as low a temperature as 0°C. [32°F.]. The late-instar larvae can be destroyed by a spray of 5–6 lb. calcium arsenate in 100 gals. water.

SAKAI (K.). **Outbreaks and Control Measures of** *Anophia leucomelas* **L. in Kagoshima Prefecture in 1938.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 222–225, 2 figs. Tokyo, 1939.

Anophia leucomelas, L., caused serious damage to sweet potato in Kagoshima Prefecture in 1937 and 1938. It has 3 or 4 generations a year, the larvae appearing in June, August and October. Sprays of calcium arsenate with a little calcium caseinate should be applied for control.

ESAKI (T.). *Saissetia nigra* **Nietn. found in southern Kyushu.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 226–228, 2 figs. Tokyo, 1939.

Saissetia nigra, Nietn., which occurs in green-houses in Japan, was observed, for the first time in the field, on *Hibiscus rosa-sinensis* in southern Kyushu. Its distribution and food-plants in the Japanese Empire are reviewed from the literature.

TAMURA (I.). **Flour of** *Amorphophallus koniac* **is damaged by** *Ptinus japonicus* **Reitt.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 229–230, 1 fig. Tokyo, 1939.

Ptinus japonicus, Reitt., was found near Tokyo infesting flour of *Amorphophallus koniac*, which is used for food in Japan. The flour was damaged by feeding and excreta, and cocoons were found in it. The life-cycle of this beetle is completed in $3\frac{1}{2}$ months. The pupal stage lasts 13 days, and the winter is passed in the adult or larval stage.

JAPAN: MINIST. AGRIC. & FOR. DEP. AGRIC. SECTION OF PLANT INDUSTRY. **Propagation of** *Rodolia cardinalis* **in Nippon.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 231–233. Tokyo, 1939.

The first record of *Icerya purchasi*, Mask., in Japan was from Okitsu, Shizuoka Prefecture in 1911, and in 1912 *Rodolia cardinalis*,

Muls., was imported for its control from Formosa. Since then, the propagation of this Coccinellid has been carried out chiefly in that Prefecture, and up to 1927 over 2,000,000 individuals had been distributed, mostly in Japan.

YAMASAKI (T.). **The Sweet Potato is damaged by** *Acanthocoris sordidus* **Thnb.** [*In Japanese.*]—*Oyo Kontyû* **1** no. 5 pp. 237–238. Tokyo, 1939.

Acanthocoris sordidus, Thnb., which is known as a pest of tomato, egg-plant, etc., in Japan, was observed attacking sweet potato in Saitama Prefecture. The growth of infested plants was retarded. This Coreid has 1 or 2 generations a year, and females deposit their eggs on the leaves, in batches containing about 16. The nymphs are gregarious, and are satisfactorily controlled by spraying with derris in soap solution.

ESAKI (T.), HORI (H.) & YASUMATSU (K.). **Insectorum Japonicorum illustratio iconographia coloribus ad naturam depicta.** [*In Japanese.*]—426 pp., Index 59 pp., 189 col. pls., many figs. Tokyo, Sanseido, 1939.

In addition to fine illustrations, this work contains a general discussion of the origin, development, morphology and biology of insects, followed by brief descriptions of some 1,500 species of all orders that occur in Japan, together with notes on the bionomics of many of them. They include both injurious and beneficial insects.

SONAN (J.). **Ants in Dwelling Houses, with a List of the Formosan Ants.** [*In Japanese.*]—*Coll. Essays 30th Yr. Establ. Govt Mus. Formosa* pp. 187–218. Taihoku, 1939.

Brief descriptions are given of the ants, *Monomorium pharaonis*, L., *Paratrechina longicornis*, Latr., *Pheidole javana*, Mayr, *Tapinoma melanocephalum*, F., *Tetramorium guineense*, F., and *Dolichoderus bituberculatus*, Mayr, which occur in houses in Formosa.

TAKAHASHI (H.). **On Insects found in Farm Yard Manure.** [*In Japanese.*]—*J. Formosan Sug. Plant. Ass.* **17** no. 1 pp. 1–6. Tainan, Formosa, 1939.

Of 9 insects found in farm-yard manure in a sugar-cane field at Tainan (Formosa), the larvae of the Cetoniid, *Liocola brevitarsis*, Lewis, the Dynastid, *Oryctes rhinoceros*, L., and the Rutelid, *Anomala expansa*, Bates, were by far the most numerous. The larvae of *A. expansa* feed chiefly on old and decayed cane in the soil and only rarely on the living parts, but they seriously damage and sometimes kill young canes when the soil is poor in decaying vegetable matter. The larvae of *O. rhinoceros* and *L. brevitarsis* feed chiefly on rotting vegetable matter and are not usually found in sugar-cane fields. *Alissonotum* spp., which are the most important of the Lamellicorns that attack sugar-cane, did not occur in the manure.

TAKAHASHI (H.). **On the seasonal Fluctuations of** *Trichogramma australicum* **Girault and** *Phanurus beneficiens* **Zehnt.** [*In Japanese.*]—*J. Formosan Sug. Plant. Ass.* **17** no. 5 pp. 265–282, 11 figs. Tainan, Formosa, 1939.

The eggs of the moth-borers attacking sugar-cane in Formosa are parasitised by *Trichogramma australicum*, Gir., *Telenomus* (*Phanurus*) *beneficiens*, Zehnt., and its variety, *elongatus*, Ishida, an unidentified species of *Telenomus* and *Trichogrammatoidea nana*, Zehnt., of which the first two are the most important. Observations carried out in Tainan from 1935 to 1937 showed that the percentage parasitism of the eggs of *Eucosma schistaceana*, Sn., by *Trichogramma australicum* throughout the year averaged 19·9, being highest (34·6) in September. It was over 25 in September–November and usually below 10 from January to July. For the eggs of *Diatraea venosata*, Wlk., the percentages averaged 57·7–74 in August, September and October, and 7·6–65·4 (mostly over 25) in the other months, except from December to February, when the host eggs are usually absent. The percentage for the year averaged 63·8. The eggs of both moths are commonest in autumn, but those of *Diatraea* are deposited in masses on the upper surfaces of the leaves and those of *Eucosma* singly on the lower surfaces. The eggs of *Chilo infuscatellus*, Sn., are parasitised by *T. australicum* throughout the year, the average percentage parasitism being 30·2. It is highest in September (43·1) or October. *Telenomus beneficiens* parasitises the eggs of *D. venosata* and to a much smaller extent those of *C. infuscatellus*. Parasitism of the former species occurs only from August to November, the percentage being 7·5–34·9.

It is evident that the percentage of eggs parasitised by these species is greater when the hosts are abundant. Heavy rains decrease the host populations, and hence the amount of rain in summer indirectly affects the numbers of the parasites.

SONAN (J.). **On the White Grub,** *Holotrichia sinensis*, **injurious to Tea Seedlings.** [*In Japanese.*]—*Formosan agric. Rev.* **35** no. 3 pp. 198–202, 2 figs. Taihoku, Formosa, 1939.

Descriptions are given of the adult, larva and pupa of *Lachnosterna* (*Holotrichia*) *sinensis*, Hope, the larvae of which attacked the roots of tea seedlings at Gyochi, Formosa, in 1936 and killed many of them. This Melolonthid has one generation a year. The overwintered larvae pupate in April and May, and the adults emerge a month later. Measures for the control of Melolonthids are reviewed from the literature, and it is recommended that the soil in nurseries should be sprayed with a suspension of lead or calcium arsenate.

SONAN (J.). **On the Tea Bark-borer** (*Linoclostis gonatias* **Meyrick**). [*In Japanese.*]—*Formosan agric. Rev.* **35** no. 4 pp. 279–283. Taihoku, 1939.

The larvae of *Linoclostis gonatias*, Meyr., all stages of which are described, bore in the bark of tea, coca [*Erythroxylon coca*], *Albizzia*, alder and other plants in Formosa. This Tineid has several generations a year; the larvae, which often kill the twigs of tea, are commonest in December.

Ramakrishna Ayyar (T. V.). **Insects and their Rôle in Indian Agriculture.**—26th Indian Science Congress, Lahore, 1939, 45 pp., 30 refs. Calcutta, R. Asiatic Soc. Bengal, 1939.

The subjects of this Presidential address to the Section of Agriculture include the growth and importance of damage by insect pests and their control, with particular reference to India ; the ways in which insects are beneficial or injurious to man ; the factors, including agricultural operations and other human activities, that influence outbreaks of pests ; the types of injury to plants for which insects are responsible ; some insect problems of national and local importance in India ; modern methods of control, both curative and preventive ; the future of economic entomology in India ; and the importance of work on systematic entomology, ecology and bioclimatics.

Noble (R. J.) & Noble (N. S.). **Aphid Vectors of the Virus of Woodiness or Bullet Disease in Passion Fruit** (*Passiflora edulis* **Sims).**—*J. roy. Soc. N.S.W.* **72** pp. 293–317, 2 pls., 1 fig., 14 refs. Sydney, 1939.

Noble (R. J.) & Noble (N. S.). **The Woodiness Disease of Passion Fruit. Aphid Carriers demonstrated.**—*Agric. Gaz. N.S.W.* **50** pt. 1 pp. 19–21, 4 figs. Sydney, 1939.

In the first of these papers, a brief account is given of the history, distribution and symptoms of the woodiness disease of *Passiflora edulis*, which has been the main cause of the decline in the yield of passion fruit in recent years in New South Wales and is also of importance in Queensland. Since previous experiments had shown that the virus could be transmitted by mechanical means but not by seed, it was considered that insects might be responsible for its spread, and a list of those found feeding on passion vines in New South Wales is given. Insects are not common on them, and infestations by possible vectors, including Jassids, thrips and the Aphids, *Myzus persicae*, Sulz., and *Macrosiphum solanifolii*, Ashm., are occasional and of brief duration. The transmission of viruses by Aphids is discussed from the literature. In a series of experiments carried out in 1936–1937, the virus was not transmitted by the thrips or Jassids tested. A further series, in 1937–1938, showed that it was transmitted by *Myzus*, *Macrosiphum*, and two unidentified species of *Aphis* that had not been seen on passion vines, but continued to feed and breed normally when transferred to them in the glasshouse. These two Aphids, which belong to the group that includes *Aphis rumicis*, L., were found on velvet beans (*Stizolobium*) and *Cotyledon* ; characters distinguishing them are described. Usually the disease developed in 6–11 days in the glasshouse, and in 10 or more out of doors ; a limited series of tests showed that one individual of *Myzus persicae* or *Aphis* sp. could transmit it. In a newly diseased plant, it appeared that the virus was present only in the leaves showing signs of infection.

In addition to the planting of healthy seedlings, the removal of young plants showing symptoms of woodiness and the complete eradication of diseased plantations before replanting, the periodical use of measures against the Aphids, at any rate in seed-beds, is recommended.

The second paper is a brief summary of the first, but includes the recommendation of a spray of 1 pint nicotine and 3 lb. soap in 75 gals. water against the Aphids.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **50** pt. 1 pp. 30–34, 5 figs. Sydney, 1939.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **27** 329] includes notes on the injury caused to vegetables and stone-fruits by the Lygaeid, *Nysius vinitor*, Bergr., and on measures for its control [**24** 212]. A dust of pyrethrum and talc (1 : 2) has given promising results against it and might be used instead of the more expensive mixture of pyrethrum and nicotine dust. A Capsid of the genus *Dicyphus*, previously reported as a pest of vegetables, including beans, tomatos and cucumbers, has recently caused damage to the fruits of peach and nectarine. Like *Nysius*, it infests orchards during hot dry weather or when adjacent crops have been cut ; it may be controlled in the same way, but a proprietary pyrethrum spray was tested against it with very satisfactory results.

Miller (D.). **Control of Weeds by Insects. Effect on Blackberry, Ragwort, and Piripiri.**—*N. Z. J. Agric.* **58** no. 1 pp. 37, 39. Wellington, N.Z., 1939.

The control of blackberry in New Zealand by means of introduced insects has been found to be impracticable, as the risk of injury to related plants of economic value is too great [*cf. R.A.E.*, A **20** 271]. Satisfactory progress is being made with the control of ragwort [*Senecio jacobaea*] by the ragwort-seed fly [*Hylemyia seneciella*, Meade], the larvae of which feed on the seeds, and it is hoped that this Anthomyiid will check the spread of the weed from neglected localities. The cinnabar moth [*Tyria jacobaeae*, L.], introduced against ragwort [*cf.* **23** 738], has become established in one locality on the Waikato river, but has died out in other places, owing to the attacks of birds and insect parasites. Field liberations have been made of the sawfly [*Antholcus varinervis*, Spin.] imported from Chile [*cf.* **20** 271] against piripiri [*Acaena*], but satisfactory control cannot be expected until the population of this sawfly has increased considerably.

Biennial Report of Insect Control Work conducted by the National Agricultural Research Bureau October 1935–June 1937.—*Spec. Publ. agric. Res. Bur. China* no. 29, 67 pp. Chungking, 1938.

Further measures against the pine caterpillar, *Dendrolimus punctatus*, Wlk. [previously stated to be *D. spectabilis*, Btlr. (*cf. R.A.E.*, A **25** 231)] on pines near Nanking were undertaken in 1936. In the period January–May, grass and undergrowth were cleared from the forest, and old bark scales containing overwintering larvae were removed from 100,000 trees ; bands of adhesives prepared in the laboratory were applied in April to 200,000 trees and gave considerable protection. Some reinfestation occurred in the summer owing to the immigration of moths from neighbouring areas, and bands were applied to the larger trees. The adhesive that had appeared the most effective in the spring proved unsatisfactory owing to the higher temperature. A description is given of work in progress on the preparation of suitable banding adhesives. In field tests on the control of *D. punctatus* on *Pinus massoniana* and *Parasa sinica*, Moore, on *Platanus orientalis*, 99·4 and 95·92 per cent. mortality, respectively, was given in 4 days by a suspension of pyrethrum in a solution of sodium carbonate

(0·5 : 0·5 : 100), and it is considered that this spray would be more economical in practice than higher concentrations that gave complete control.

Insects injurious to vegetables in Nanking during 1935–36 included *Brevicoryne* (*Aphis*) *brassicae*, L., *Phaedon brassicae*, Baly, *Colaphellus bowringi*, Baly, *Hellula undalis*, F., *Pieris rapae*, L., and *Phyllotreta vittata*, F. Applications under field conditions of a stock pyrethrum-kerosene emulsion in water (1 : 30 at high temperatures and 1 : 20 at low ones) and a 1 per cent. suspension of lead arsenate each gave over 95 per cent. control of the Aphid, *P. rapae*, *P. brassicae*, *C. bowringi* and *P. vittata*, and the lead arsenate was also effective against *H. undalis*. Tables show the percentage mortalities given at Nanking in 1935–36 by various insecticides applied against insect pests of fruits and other plants, and the insects that attacked vegetables at Nanking and Shanghai during 1936–37. During 1936, a survey of insects attacking fruit, especially pears, peaches and apples, in Shantung was made, and a list of these is given, showing the food-plants and the stages in which infestation and hibernation take place. The most important included *Cydia* (*Laspeyresia*) *molesta*, Busck, *Anthonomus pomorum*, L., and *Rhynchites heros*, Roel., which caused serious injury to the fruits of pear; *Dichocrocis punctiferalis*, Gn., attacked the fruit and *C. molesta* the stems of peach, and *Urochela luteovaria*, Dist., and *Paranthrene* (*Sciapteron*) *regalis*, Btlr., the stems of pear and grape, respectively. The most important of the leaf feeders was *Illiberis pruni*, Dyar, on apple and pear. Experiments showed that infestation was reduced when the fruit was enclosed in bags. Against the Zygaenid on the leaves of fruit trees, the best results were given by a 1 per cent. lead arsenate spray, an average mortality of 90 per cent. being obtained.

An outbreak of locusts that caused serious damage to wheat in June 1936 was controlled by driving the nymphs into ditches dug near the fields and burning them, and by exposing them to attack by ducks. About 90 per cent. control of the nymphs that migrated to maize fields was given by an insecticide made from a tree (*Celastrus angulatus*), which is also effective against the adults.

In field tests in 1935 with insecticides prepared from the bark of the root and from the leaves of this tree and of *Trypterygium wilfordi* and the flowers of *Rhododendron sinense* against *Colaphellus bowringi* on cabbage, over 90 per cent. control was given by any one of the insecticides in soap solution at the rate of 74 gm. powder, 20 gm. soap and 600 cc. water, and by an alcohol extract of *R. sinense* in soap solution at the rate of 50 cc. extract and 20 gm. soap in 600 cc. water, all diluted with 4 parts water. In cage tests carried out during 1936 with insecticides prepared from these plants and from *Millettia reticulata* and used as stomach poisons against adults of *Colaphellus bowringi* and nymphs of *Locusta migratoria migratorioides*, R. & F., *Millettia* gave the best control (100 per cent.) of the beetle and *Celastrus* of the locust. They all gave unsatisfactory results when used as contact poisons against mature larvae of *C. bowringi*.

Experiments on the toxicity of pyrethrum extracts to *C. bowringi* indicated no significant increase in mortality when the period during which the flowers were extracted in kerosene varied from 1 to 8 days; when it was 10 days, it rose from 68 to 71 per cent., and after longer periods the toxicity of the extract varied directly with the period of immersion.

Plant Pathology and Entomology.—*Misc. Publ. agric. Res. Bur. China* no. 7 (Rep. 1936) pp. 46–52. Chungking, 1938.

Much of the entomological information contained in this Report for the year 1936 has been noticed in the preceding abstract.

The pine caterpillar, *Dendrolimus punctatus*, Wlk., passed through two generations instead of three as in 1935, and individuals of the first appeared in June. Experiments indicated that the period for which the larvae can survive without food varies directly with their age, and inversely with the temperature ; third-instar larvae survived starvation for 10 days at 27°C. [80·6°F.]. The percentages of larvae hibernating under the bark of the trunks and in leaves and twigs were 95 and 5, respectively.

When stored products were fumigated in a box with ½ lb. chloropicrin, the percentage mortalities of adults of *Calandra oryzae*, L., after 24 hours and eggs of *Bruchus chinensis*, L., after 96 hours were 100 and 90, respectively. The mortality of larvae of *Sitotroga cerealella*, Ol., resulting from 48 hours exposure to chloropicrin (2 lb.) was 95 per cent. On exposure to hydrocyanic acid gas, the percentage mortalities of larvae and adults of *Tribolium castaneum*, Hbst., were 94·5 and 100, respectively ; those of the larvae and adults of *Tenebroides mauritanicus*, L., were 98·68 and 86·81, respectively ; and that of the larvae of *Aphomia gularis*, Zell., and *S. cerealella* was 100.

Insects attacking sugar beet in Shantung include *Cicadella* (*Tettigoniella*) *viridis*, L., in addition to those already noticed [*R.A.E.*, A **25** 746]. In experiments on the control of *Epicauta gorhami*, Mars., *Hymenia recurvalis*, F. (*Zinckenia fascialis*, Stoll), and *Barathra brassicae*, L., sprays containing calcium arsenate alone or with lime gave percentage mortalities of 87–96 and were more satisfactory than sprays containing Szechan bean seed in a solution of sodium carbonate, soap solution, preparations of *Celastrus angulatus* or dusts of lime alone or with pyrethrum.

Outbreaks of the migratory locust [*Locusta migratoria*, L.] occurred in the provinces of Kiangsu, Chekiang, Anhwei, Hunan, Shantung and Hopei [*cf.* **25** 62]. Millet is the crop most seriously damaged, others attacked including maize, wheat, reeds and rice. Outbreaks of the bamboo locust [*Ceracris kiangsu*, Tsai] were fairly severe in Hunan during 1936.

Silayan (H. S.). **Annual Report of the Director of Plant Industry for the fiscal Year ending December 31, 1937.**—182 pp., 23 pls. Manila, Philipp. Dep. Agric. Comm., 1938.

Sections of this report (pp. 20–28, 76–78) deal with insect pests and their control in the Philippines during 1937. Infestation by *Locusta migratoria manilensis*, Meyen, is now confined to an area of about 1,400 acres in 12 provinces [*cf. R.A.E.*, A **25** 791]. The principal crops injured were maize, rice, sugar-cane and coconut.

Insects injurious to coconut included *Oryctes rhinoceros*, L., *Artona catoxantha*, Hmps., *Promecotheca cumingi*, Baly, *Chrysomphalus ficus*, Ashm., *Thosea* spp. and *Erionota thrax*, L., which also occurred on banana. Insect pests observed on other crops during the year included *Nymphula depunctalis*, Gn., *Cnaphalocrocis medinalis*, Gn., *Oxya velox*, F., *Scirphophaga innotata*, Wlk., and *Schoenobius bipunctifer*, Wlk. (*incertellus*, Wlk.) on rice ; *Heliothis virescens*, F.,

on tobacco ; *Pyrausta nubilalis*, Hb., the corn ear worm [*Heliothis armigera*, Hb.] and the silk beetle [*Monolepta varicornis*, Lec.] on maize ; *Prays citri*, Mill., and *Rhynchocoris longirostris*, Stål, on *Citrus* ; and the pod borer [*Acrocercops cramerella*, Sn.] on cacao [*cf.* **25** 478].

Studies in progress on insects and insecticides are very briefly reviewed. Improved methods of rearing the imported egg parasite, *Trichogramma minutum*, Riley, in large numbers were developed. The imported toad, *Bufo marinus* [*cf.* **24** 121] showed promise of becoming established in Laguna, and studies on the feeding habits of native frogs and toads are in progress with a view to utilising them in the control of pests of rice and other crops.

Iyriboz (Nihat). **Zeytin Hastaliklari.** [Agricultural Diseases. 1. Diseases of Olives.] [*In Turkish*].—*Publ. Minist. Turk. Rep.* no. 322, 74+viii pp., text ill., 11 refs. Ankara, 1938. **Bağ Hastaliklari.** [2. Diseases of Vines.] [*In Turkish*].—*Op. cit.* no. 323, 213+viii pp., text ill., many refs.

The first of these bulletins comprises an account of the principal pests and diseases of olive in various countries, about 50 pages being devoted to insects. This section includes descriptions of the various species and records of the distribution of some of them in Turkey, and gives suggestions for their control.

The second bulletin deals in a similar way with the pests of vines.

Anagnostopoulos (P. T.). **Pests of Hazel, Chestnut and Pistachio.** [*In Greek.*]—*Dendrok. Ereuna* [Hort. Research] 1938 no. 3 pp. 497–544, 28 figs. Athens, 1938.

This paper comprises very brief notes on the fungi and insects in Greece that attack hazel [*Corylus avellana*] and chestnut and a more detailed account of those that attack pistachio (*Pistacia vera*). The insects concerned are *Curculio* (*Balaninus*) *nucum*, L., *Oberea linearis*, L., and *Zeuzera pyrina*, L., as well as the mite, *Eriophyes avellanae*, Nal., on hazel ; *Cydia* (*Carpocapsa*) *splendana*, Hb., *Curculio* (*Balaninus*) *elephas*, Gylh., and *Stephanitis* (*Tingis*) *pyri*, F., on chestnut ; and *Tinea pistaciae*, Anagnos., *Eurytoma pistaciae*, Anagnos., *Megastigmus* (*Trogocarpus*) *ballestrerii*, Rond. [*cf. R.A.E.*, A **23** 567], *Idiocerus pistaciae*, Anagnos., *Hylesinus* (*Chaetoptelius*) *vestitus*, Muls. & Rey [*cf.* **14** 614], and *Pulvinaria pistaciae*, Bodenh., on pistachio.

Tinea pistaciae has five generations in the year, the adults of which emerge and oviposit in May and early June, late June, late July, August–September and October–November. The eggs of the first generation hatch in June, and the larvae immediately bore into the kernel of the fruit ; their entrance holes give access to spores of *Phomopsis*, a fungus that causes the fruit to dry and turn black. The larvae of the second and third generations burrow in the flesh of the fruit, being unable to penetrate the harder kernel, those of the fourth generation enter the late fruits, and those of the fifth the shoots, where they hibernate in or near the tips.

E. pistaciae and *M. ballestrerii* infest the kernels and have very similar bionomics. Reference is made to the work of T. de Stefani on the biology of *M. ballastrerii* in Sicily [**7** 87]. The adults of *Eurytoma* appear in May and June, and the period from July to the following April is spent in the larval stage.

ANAGNOSTOPOULOS (P. T.). **A new Damage to the Fruits of the Pistachio (by the Fungus *Phomopsis* sp.).** [*In Greek.*]—*Dendrok. Ereuna* [Hort. Research] 1938 no. 3 pp. 566–574, 3 figs., 1 ref. Athens, 1938. (With a Summary in English.)

Observations on the fungus of the genus *Phomopsis* that infests the fruits of pistachio (*Pistacia vera*) in Greece showed that it is carried in spring by a species of *Sciara*, and possibly persists from year to year in fruits that are damaged by *Megastigmus* (*Trogocarpus*) *ballestrerii*, Rond., and *Eurytoma pistaciae*, Anagnos., and are left on the trees. In both spring and autumn it infests fruits previously attacked by *Tinea pistaciae*, Anagnos. [*cf.* preceding abstract]. Methods of control, in addition to those that may be directed against the insects, include the destruction of the fruits, twigs and leaves infested by the fungus, and spraying with Bordeaux mixture.

SCLEROS (N.). **Observations on the Olive Fruit Fly (*Dacus oleae*, Rossi).** [*In Greek.*]—*Dendrok. Ereuna* [Hort. Research] 1938 no. 3 pp. 545–565, 3 refs. Athens, 1938. (With a Summary in English.)

The author records observations on the bionomics of *Dacus oleae*, Gmel., in Greece, with notes on those of a species of *Lasioptera* that infests olives in which *Dacus* has oviposited. He found that the use of bait sprays against *D. oleae* gave doubtful and contradictory results, and that further investigation on them is required.

[Reports of the scientific Meetings of the Leningrad Institute of Agriculture]. 5 nos., Leningrad, 1939.

In " The regional Distribution of agricultural Crops according to the Complexes of Pests occurring in them (4 pp.)," G. Ya. Beĭ-Bienko emphasises the fact that a knowledge of the distribution of the complex of pests (and not only of individual species) associated with certain crops is of considerable value in the organisation of control measures. For this purpose, investigations were made from 10th July to 12th August 1937 on the insect fauna in wheat fields in five widely separated localities in northern Kazakstan between Aktyubinsk and Kustanaĭ, collections of insects being made from sample plots at various periods during the different phases of development of the wheat from milky ripeness to full maturity. Of the 74 species of insects taken in the whole region, 20 were common to all the localities examined. These included the wheat thrips [*Haplothrips tritici*, Kurdj.], the grain Noctuid [*Trachea basilinea*, F.], the barley aphis [*Brachycolus noxius*, Mordv.], the maize aphis, *Sipha maydis*, Pass., the Pentatomid, *Aelia sibirica*, Reut., the Jassids, *Laevicephalus* (*Deltocephalus*) *striatus*, L., and *L.* (*D.*) *collinus*, Boh., and the flea-beetles, *Phyllotreta vittula*, Redt., and *Chaetocnema aridula*, Gylh., and the predators, *Aeolothrips fasciatus*, L., *Orius* (*Triphleps*) *niger*, Wolff, *Chrysopa* sp., and *Adonia variegata*, Gze. Thus, the fields of wheat in the steppe zone of northern Kazakstan harbour a homogeneous insect fauna during the period of the ripening of the wheat, and control measures such as autumn ploughing and destruction of the stubble should, therefore, be carried out

throughout the whole region against *H. tritici*, *T. basilinea* and *B. noxius*.

In " Problems of the regional Distribution of *Oscinella frit* L. (2 pp.)," E. A. Kreĭter states that in the Russian Union *O. frit* has been recorded from the western frontier to the Russian Far East and from 67°N. Lat. (Kola peninsula) to 42°N. Lat. (Transcaucasia). Laboratory investigations [*cf. R.A.E.*, A **19** 283] showed that its thermal limits of development are 8 and 40°C. [46·4 and 104°F.] and that the length of its life-cycle varies from 18 days at 34°C.[93·2°F.] to 69 days at 15°C. [59°F.]. The development of a generation requires a sum of effective temperatures of 400°C. [720°F.]. The number of generations in a year varies, therefore, from one near Murmansk (Kola peninsula) to five near Krasnodar (North Caucasus), but injury is caused only in zones in which there is a favourable combination of temperature and humidity. The ears of oats and barley are attacked only in districts in which during the period of formation of the ears the monthly temperature averages not more than 18°C. [64·4°F.] and the relative humidity at 1 p.m. is not less than 50 per cent. By calculating indices showing the relation of the total precipitation during the period of activity of the fly to the sum of effective temperatures during the same period, it has been found that in the European part of the Russian Union constant damage by the pest is caused where this index is 18–24. In regions in which it is 25–32 or 17–11, the fly is abundant, but becomes economically important only in years of favourable weather (increase of temperature in the north or increase of humidity in the south). In regions in which the index is 42–33 or less than 11, the fly is present, but is not a pest.

In " The Effect of the Feeding of the Larvae of the Pea Weevils (*Sitona lineata*, L. and *Sitona crinita*, Hbst.) on the Content of Nitrogen in the Root System of Peas and Vetches, as well as on the general Balance of the biologically bound Nitrogen in the Soil (4 pp.)," N. S. Turaev points out that the feeding of the larvae of *S. lineata* and *S. crinita* on the nodules of leguminous plants decreases the yield of seed and straw in direct proportion to the degree of infestation and the lack of nitrogen in the soil, and also reduces their quality by lowering the protein content. A correct estimate of the injuriousness of the larvae cannot, however, be obtained by calculating the yield from infested plants, as in the case of crops growing in soils rich in nitrogen, the damage is compensated by the extra nitrogen supplied. Laboratory investigations showed that the percentage of nitrogen in the root system of infested leguminous plants is inversely proportionate to the degree of infestation. This percentage depends on two variables, namely the number of nodules that have escaped infestation and the corresponding degree of development of the root system, and a formula is given by which it may be calculated.

In " Results of Experiments with the Application of *Cryptolaemus* for the Control of Mealybugs in Abkhazia (2 pp.)," D. G. Kolotov states that in field tests in 1938 in Abkhazia, the Coccinellid, *Cryptolaemus* [*montrouzieri*, Muls.] was released at the rates of 5 and 10 adults per tree against *Pulvinaria aurantii*, Ckll., on *Citrus* on 3rd June, by which date 20–30 per cent. of the females of the pest had oviposited, and again on 14–15th June when this percentage was 50–70. At the lower rate of release, the predator did not effect any appreciable control in severely infested orchards, but when 10 individuals per tree were released, the first generation of the pest was reduced by an

average of 94·9 per cent. The Coccinellid was also released in tea plantations against *P. floccifera*, Westw., at the rates of 2, 4 and 8 thousand per acre, and reduced the numbers of the Coccid by up to 87·4 per cent. The predator produced one complete generation and a partial second. It should be released at the very beginning of the oviposition period of the pest, and as it does not spread rapidly, it should be liberated at several points in the plantations [*cf.* **24** 676]. In the absence of the eggs of Coccids, it gradually dies out.

In " Prospects of the microbiological Method of Controlling Pests (2 pp.)," V. P. Pospelov deals with the utilisation of pathogenic bacteria and fungi for the destruction of insect pests [*cf.* **25** 153; **27** 306]. Bacteria isolated from larvae of the wax moth [*Galleria melonella*, L.], and cultured on potato or potato agar proved to be particularly virulent. Spraying cultures of these bacteria in water was effective against larvae of the large cabbage butterfly [*Pieris brassicae*, L.], the small cabbage butterfly [*P. rapae*, L.], the apple moth [*Hyponomeuta padellus malinellus*, Zell.] and other insects under both laboratory and field conditions. The spores retained their virulence for several years when preserved in the form of a powder and mixed with potato flour or tripoli earth.

In " Sterility of Lepidoptera under the Effect of increased Temperature and insufficient Humidity (2 pp.)," Pospelov states that in the females of Lepidoptera that emerge with immature eggs, such as *Loxostege sticticalis*, L., and *Agrotis segetum*, Schiff., egg-maturation is retarded by abnormally high temperatures and low humidity. If such conditions continue during the adult stage, the females are sterile. If the pupae develop under normal conditions of temperature and humidity, the resulting females possess fairly mature ovaries; but if hot, dry weather sets in, the eggs degenerate and the moths do not oviposit. Sterility may also result from abnormal fertilisation owing to high temperatures and insufficient humidity, which affect the male sperm or spermatophores.

Burr (M.). **The Insect Legion.**—Demy 8vo, xiv+321 pp., frontis., 15 pls., 5 figs. London, J. Nisbet & Co. Ltd., 1939. Price 12*s.* 6*d.*

In the first part of this book, the author gives a popular account of insect biology, and in the second, he emphasises the great importance of insects to man. The economic importance of both harmful and beneficial insects and the control of the former are discussed, with an account of the history of entomology in ancient and modern times.

Papers noticed by Title only.

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